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State of Connecticut



# The Connecticut Agricultural Experiment Station

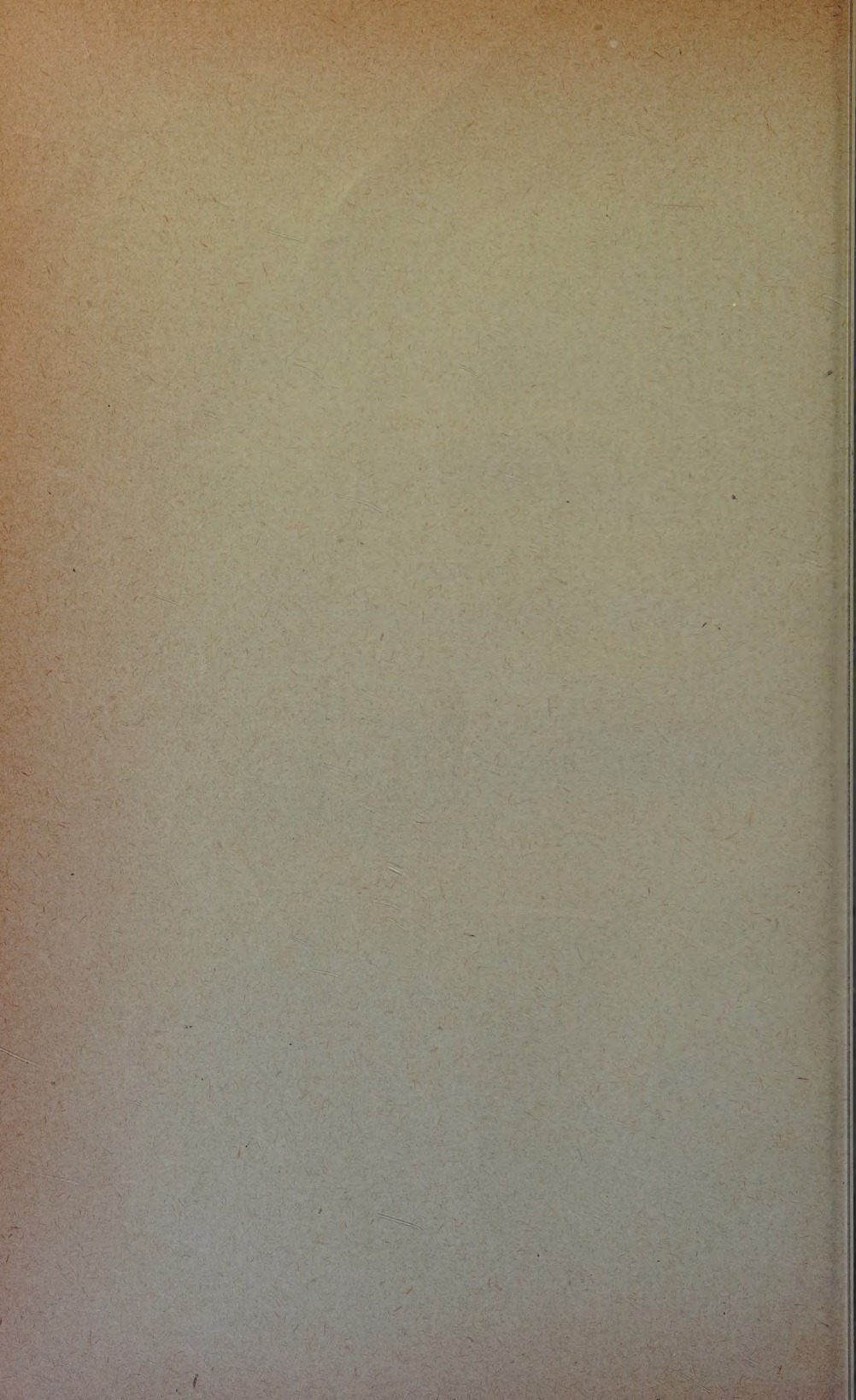
NEW HAVEN, CONN.

**Bulletin 218**

BEING THE

**NINETEENTH REPORT OF THE STATE  
ENTOMOLOGIST FOR 1919**

W. E. BRITTON, PH.D.





NINETEENTH REPORT  
OF THE  
STATE ENTOMOLOGIST  
OF  
CONNECTICUT  
FOR THE YEAR 1919

(Being Bulletin 218 Connecticut Agricultural Experiment Station)

BY  
W. E. BRITTON, PH.D.  
State Entomologist

NEW HAVEN, CONN.

1920

# CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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## NOTE REGARDING AUTHORSHIP.

For bibliographical purposes all matter in this report (Bulletin 218) should be credited to W. E. Britton except where otherwise indicated.



BULLETIN 218  
NINETEENTH REPORT  
OF THE  
State Entomologist of Connecticut

*To the Director and Board of Control of the Connecticut Agricultural Experiment Station:*

I submit, herewith, my nineteenth report as State Entomologist of Connecticut for the year 1919. Pursuant to the action of the General Assembly in changing the time of beginning of the fiscal year, the financial statement covers the nine months ending June 30, 1919. As much of the work of the department extends through the summer, the other part of this report covers the season as usual, and includes brief reports of the work of inspecting nurseries, imported nursery stock and bulbs, apiaries, and suppressing the gipsy moth: also separate accounts of the white pine weevil, the pine bark aphid, various borers and other insects attacking corn in Connecticut, outbreak of the green clover worm on beans, chrysanthemum gall midge experiments, progress of mosquito extermination work, and miscellaneous notes on common pests and unusual insects of the season.

Respectfully submitted,

W. E. BRITTON,

*State and Station Entomologist.*

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST  
FROM OCTOBER 1, 1918, TO JUNE 30, 1919.

RECEIPTS.

|                                             |            |
|---------------------------------------------|------------|
| From E. H. Jenkins, Treasurer .....         | \$4,500.00 |
| Account of 1918, Balance .....              | 1,440.71   |
| State Comptroller, Gipsy Moth Account ..... | 541.98     |
| M. P. Zappe, Automobile Mileage .....       | 4.20       |
|                                             | <hr/>      |
|                                             | \$6,486.89 |

EXPENDITURES.

For Field, Office and Laboratory Assistance:

|                                 |            |
|---------------------------------|------------|
| B. H. Walden,* salary .....     | \$1,166.64 |
| M. P. Zappe, salary .....       | 1,125.00   |
| K. F. Chamberlain, salary ..... | 420.00     |

\* For seven months: remainder paid from mosquito appropriation.

|                                     |          |                  |
|-------------------------------------|----------|------------------|
| Martha DeBussy,† salary .....       | \$336.00 |                  |
| Gladys M. Finley, salary .....      | 222.00   |                  |
| Other Assistance .....              | 169.67   |                  |
|                                     |          | <hr/> \$3,449.31 |
| Printing and Illustrations .....    | 50.50    |                  |
| Postage .....                       | 30.13    |                  |
| Stationery .....                    | 23.37    |                  |
| Telegraph and Telephone .....       | 4.58     |                  |
| Office Supplies .....               | 37.10    |                  |
| Library .....                       | 224.62   |                  |
| Machinery, Tools and Supplies ..... | 143.95   |                  |
| Express Freight and Cartage .....   | 3.61     |                  |
| Traveling Expenses .....            | 350.41   |                  |
| Automobile Tires and Repairs .....  | 279.56   |                  |
| Balance Cash on Hand .....          | 1,889.75 |                  |
|                                     |          | <hr/> \$6,486.89 |

*Memorandum.*—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of \$541.98 credited as having been received from the State Comptroller is really a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage of members of the department staff while engaged in inspecting imported stock.

The reason for making this financial statement cover nine months instead of a full year is on account of the change in the beginning of the fiscal year from October 1st to July 1st, made by the last session of the Legislature.

#### SUMMARY OF INSPECTION AND OFFICE WORK.

- 305 samples of insects received for identification.
- 96 nurseries inspected.
- 88 regular certificates granted.
- 22 parcels of nursery stock inspected and certified.
- 57 orchards and gardens examined.
- 131 shipments, containing 1,075 cases, 1,164,701 plants, imported nursery stock inspected.
- 44 shipments or 33.5 per cent. found infested with insects or fungi.
- 317 shipments, containing 924 cases, 1,529,775 imported bulbs inspected.
- 723 apiaries, containing 6,070 colonies inspected.
- 48 apiaries, containing 78 colonies found infested with European foul-brood.
- 22 apiaries, containing 69 colonies found infested with American foul-brood.
- 2,308 letters written on official work.
- 121 circular letters.
- 621 post cards.

† Resigned March 4, 1919.



- 254 reports of inspection to Federal Horticultural Board.
- 798 bulletins, etc., mailed on request or to answer inquiries.
- 51 packages sent by mail or express.
- 23 lectures and addresses at institutes, granges, etc.

## PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1919.

By *W. E. Britton.*

- Eighteenth Report of the State Entomologist (Bulletin 211), 108 pages, 7 figures, 16 plates; 10,000 copies distributed in May, 1919.
- Insects Attacking the Potato Crop in Connecticut (Bulletin 208), 20 pages, 6 figures, 8 plates; 10,000 copies distributed in March, 1919.
- Report of Committee on Injurious Insects, Report of Connecticut Vegetable Growers Association for 1918, page 28, 1919.
- Report of Committee on Injurious Insects, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 95, 1919.
- The European Corn Borer, Proceedings Twenty-Eighth Annual Meeting Connecticut Pomological Society, page 159, 1919.
- Progress in Mosquito Control in Connecticut in 1917. Proceedings Fifth Annual Meeting New Jersey Mosquito Extermination Association, page 100, 1918.
- The Iris Borer Again, *Florists' Exchange*, Vol. xlv, page 531, October 5, 1918.
- The Chrysanthemum Midge, *Florists' Exchange*, Vol. xlvii, page 45, January 11, 1919.
- Insects Attacking Maples and Elms, *Florists' Exchange*, Vol. xlvii, page 1,331, June 28, 1919.
- A Tree Protection Institute, *Florists' Exchange*, Vol. xlviii, page 205, August 2, 1919.
- Book Review—Washburn's Injurious Insects and Useful Birds, *Science*, Vol. xlix, page 425, May 2, 1919.
- Elm Leaf Beetle, *New Hampshire Sentinel*, July 23, 1919.
- Automobile Truck Power Sprayers, *American Fruit Grower*, 2 figures, page 6, October, 1919.
- Corn Borers, *New England Farms*, June 28, 1919.
- Corn Borers, *Connecticut Agricultural College Press Bulletin*, July 10, 1919.
- Corn Borers, *Hartford County Farm News*, July, 1919.
- Tree Protection Institute, *Hartford County Farm News*, July, 1919.

By *W. E. Britton and M. P. Zappe.*

- Kerosene Emulsion versus Nicotine Solution for Combating the Potato Aphid, *Journal of Economic Entomology*, Vol. 12, page 71, 1919.

By *M. P. Zappe.*

- Aphis Control, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 145, 1919.

## DEPARTMENT STAFF

|                         |                                        |                               |
|-------------------------|----------------------------------------|-------------------------------|
| W. E. BRITTON, PH.D.,   | <i>State and Station Entomologist.</i> |                               |
| B. H. WALDEN, B.AGR.,   | <i>Photographic and Mosquito Work.</i> | } Assistant<br>Entomologists. |
| IRVING W. DAVIS, B.SC., | <i>Deputy in Charge of Moth Work.</i>  |                               |
| MAX P. ZAPPE, B.S.,     | <i>Inspection and General Work.</i>    |                               |
| KENYON F. CHAMBERLAIN,* | <i>Inspection and General Work.</i>    |                               |
| PHILIP GARMAN, PH.D.,†  | <i>Research Work.</i>                  |                               |
| MISS MARTHA DEBUSSY,‡   | } <i>Clerks and Stenographers.</i>     |                               |
| MISS GLADYS M. FINLEY,§ |                                        |                               |
| H. W. COLEY, Westport,  | } <i>Apiary Inspectors.</i>            |                               |
| A. W. YATES, Hartford,  |                                        |                               |

Messrs. Walden and Zappe have continued as assistants in the general work of the department. Mr. Chamberlain, who was employed to inspect nurseries in 1918, was reengaged for the season beginning February 24. Mr. Davis was discharged from military service and resumed his duties in charge of the gipsy moth work January 15. During his absence Mr. Ashworth acted as superintendent and deputy.

Dr. Philip Garman, a graduate of the University of Kentucky, class of 1913, was appointed a member of the staff and began his duties September 1. Dr. Garman was a graduate student at the University of Illinois, receiving his doctor's degree in 1916. He was then assistant entomologist at the Maryland Agricultural Experiment Station for three years. Though Dr. Garman may be called upon sometimes to assist in the general work of the department, he will be engaged chiefly in research in connection with injurious and beneficial insects.

Miss Martha DeBussy served as clerk and stenographer from August 26, 1918, to March 4, 1919, when she resigned to accept a position with larger salary. Miss Gladys M. Finley was appointed to fill the position.

Messrs. Coley and Yates have made the inspections of apiaries, as in preceding years, on a *per diem* basis.

Mr. Walden has continued to serve as deputy to the Director in mosquito elimination work, which required nearly all of his time during the summer months. He has done considerable photographic work and has aided in the inspection of nurseries, imported nursery stock and bulbs. He has been in charge of the

\* Beginning February 24.

† Beginning September 1.

‡ Resigned March 4.

§ Beginning March 6.



department during the absence of the Entomologist. Mr. J. Kirby Lewis was employed from August 11 to October 4 to inspect nurseries and bulbs. Mr. Geo. D. Stone, who has been on the gipsy moth force, was employed around Milford in April and May, and again in July to examine corn fields over the state. He also helped to inspect nurseries and imported bulbs, returning in October to the gipsy moth work.

All of the regular members of the staff and the temporary assistants mentioned above have rendered faithful and efficient services which have been appreciated.

#### CHIEF LINES OF WORK.

The regular inspection work as provided for by statute, such as the gipsy and brown-tail moth work, the inspection of nurseries, orchards, gardens, etc., the inspection of imported nursery stock and apiaries has been conducted as in former years.

At the suggestion of the Federal Horticultural Board made during the summer, an attempt has been made to examine all bulbs imported from foreign countries. These shipments began arriving about August 1st, and during the next four months we inspected more than three hundred separate shipments containing 924 cases of bulbs.

Mr. Walden has continued as deputy to the Director in charge of the mosquito drainage work of the state, which during the year has for the most part been maintenance. A few new tide gates have been built, and there have been extensions to the drainage systems in a few towns, but no extensive new work has been carried out.

Mr. Zappe conducted experiments in controlling the chrysanthemum gall midge *Diarthronomyia hypogaea* Loew., in two large commercial greenhouses, in the late winter, and has also continued his studies on the life history of an undescribed sawfly of the genus *Itycorsia* which feeds upon Austrian pine.

Messrs. Zappe and Britton have continued the field experiments begun five or six years ago for the control of the insects attacking cucumbers, squashes, pumpkins and melons in Connecticut. The Entomologist has prepared a paper on this subject which was published as Bulletin No. 216.

Dr. Garman, who began his duties September 1, has already worked out the life history of the bulb mite, *Rhizoglyphus echin-*

*opus* Fumouse and Robin, which up to that time had not been published. The results of his studies are now being prepared for publication.

On account of the menace of the European corn borer, *Pyrausta nubilalis* Hubner, much scouting has been done in various parts of the State to learn whether or not the pest occurred in Connecticut. Though up to this time it has not been found within our State, several borers resembling it were discovered. All are native or long established species, which in themselves need cause no alarm. Many corn fields were visited in late winter and the corn stalks examined in the shock or as left standing in the field. In Milford where borers were found in the stalks, through co-operation with the owners, the stalks were cut and burned in several fields. Mr. George D. Stone was in immediate charge of this work.

Later in the season, Mr. Stone visited a number of towns in each county, and examined the growing corn in the fields, sending to the laboratory specimens of all insects found attacking the corn crop.

In the following pages of this report, the various papers describe in detail these lines of effort.

By action of the General Assembly, the Entomologist is a member of the new Tree Protection Examining Board, and at present he is serving as Chairman of the Board.

The Entomologist has also co-operated with the Farm Bureaus, and has furnished information about insect pests where needed.

Some time and attention during the year has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

### INSPECTION OF NURSERIES.

The annual inspection of nurseries commenced on August 7, but on account of the unusual abundance of rainy weather and the arrival of shipments of imported bulbs to be inspected, the work was retarded and not finished until October 29. Most of this inspection work was done by Messrs. Zappe, Chamberlain, Walden, Lewis, Davis and Stone, but occasionally they were assisted by Messrs. Garman and Britton. Mr. Lewis was employed temporarily from August 11 until October 4 for this purpose. Mr. Stone, who had been borrowed from the gipsy



moth force service to inspect corn fields, was also pressed into service to inspect nurseries, but returned to gipsy moth work on October 8. Mr. Davis inspected practically all of the nurseries in the eastern part of the State.

The men were transported chiefly by automobile, but Mr. Stone travelled to many outlying nurseries on his motorcycle.

The system of inspection adopted was similar to that of former years. Where important pests were found the trees or plants were marked, and the owner or manager was instructed to destroy or treat them as the needs of the case required. Certificates were not granted until a written statement was received that the directions had been carried out.

In inspecting nurseries year after year, the same kinds of pests are found though they may vary somewhat in the order of their abundance. Thus in 1919 the number of nurseries infested by our common nursery pests corresponds very closely to that of 1918, and is as follows:—

Insects:—Oyster-Shell Scale 38; San José Scale 19; Spruce Gall Aphid 19; White Pine Weevil 5; Tulip Tree Scale 4; Pine Leaf Scale 3; Scurfy Scale 3; Elm Scale 2; Euonymus Scale 2; Green Apple Aphid, *Chermes cooleyi*, Woolly Aphid, Rose Scale, Pine Tube Moth, Peach Borer and Leopard Moth, one each.

Plant Diseases:—Poplar Canker 5; Black Knot of Plum, Fire Blight, and Crown Gall, one each.

In 32 nurseries no pests were found.

As in 1918, the oyster-shell scale was the most common and abundant pest on nursery stock, and before certificates could be granted many trees and shrubs had to be destroyed. San José scale infestations were about the same as last year. The tulip tree scale was found in four nurseries, but was entirely absent in 1918. The Oriental peach moth *Laspeyresia molesta* Busck was not found in any nursery.

Four new nurseries and one old nursery were inspected in the spring and certificates granted; they were again inspected in the fall and are marked (2) on the list.

Twenty-two packages were inspected and certificates granted.

Of the 83 names on the list of nurserymen for 1919, six are new, the names of two have been changed and three have gone out of business. Six nurseries had not destroyed or treated their infested stock in time to receive certificates before this report

went to press. The acreage devoted to the growing of nursery stock remains about the same as last year.

The list for 1919, with location, acreage, date and number of certificate of each is as follows:—

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919.

| Name of Firm.                                                | Address.                         | Acreage. | Certificate Issued. | No. of Certificate. |
|--------------------------------------------------------------|----------------------------------|----------|---------------------|---------------------|
| Barnes Bros. Nursery Co.....                                 | Yalesville .....                 | 150      | Sept. 9             | 1003                |
| Beattie, Wm. H.....                                          | New Haven .....                  | 1        | Sept. 22            | 1011                |
| Bertolf Bros. ....                                           | Sound Beach ....                 | 25       | Oct. 1              | 1022                |
| Brainard Nursery & Seed Co....                               | Thompsonville ..                 | 6        | Nov. 5              | 1055                |
| Braley & Co.....                                             | Burnside .....                   | 1        | Sept. 2             | 995                 |
| Bretschneider, A. ....                                       | Danielson .....                  | 1        | Sept. 11            | 999                 |
| Brown, F. K. (2).....                                        | Greenwich .....                  | 2        | Sept. 26            | 1017                |
| Burr & Co., C. R.....                                        | Manchester, Ellington and Durham | 500      | Sept. 9             | 1000                |
| Burroughs, Thos. E. ....                                     | Deep River .....                 | 3        | Sept. 26            | 1015                |
| Chapman, C. B.....                                           | Groton .....                     | 1        | Sept. 11            | 1006                |
| Chapman, C. E.....                                           | North Stonington                 | 4        | Sept. 11            | 1005                |
| Coari & Co. (2).....                                         | Norwalk .....                    | 2        | Oct. 10             | 1042                |
| Conine Nursery Co. ....                                      | Stratford .....                  | 50       | Sept. 23            | 1012                |
| Conley, L. D.....                                            | Ridgefield .....                 | 5        | Oct. 1              | 1025                |
| Conn. Agricultural College (Prof. S. P. Hollister).....      | Storrs .....                     | 1        | Sept. 2             | 990                 |
| Conn. Agr. Experiment Station (W. O. Filley, State Forester) | New Haven .....                  | 1        | Oct. 7              | 1034                |
| Conway, W. B.....                                            | New Haven .....                  | 1        | Nov. 6              | 1059                |
| Croft & Knapp Farm.....                                      | Norwalk .....                    | 20       | Nov. 12             | 1066                |
| Cross Highway Nurseries.....                                 | Westport .....                   | 6        | Nov. 5              | 1057                |
| Dallas, Inc., Alexander.....                                 | Waterbury .....                  | 1        | Aug. 30             | 989                 |
| Elm City Nursery Co., Woodmont Nurseries, Inc. ....          | Woodmont & New Haven .....       | 155      | Sept. 27            | 1018                |
| Fairfield Landscape & Nurseries Co. ....                     | Cannondale .....                 | 5        | Nov. 10             | 1063                |
| Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)....  | Litchfield .....                 | 1        | Sept. 26            | 1016                |
| Gardner's Nurseries .....                                    | Cromwell .....                   | 10       | Oct. 30             | 1050                |
| Geduldig, Estate of G.....                                   | Norwich .....                    | 1        | Nov. 12             | 1065                |
| Goodwin Associates, Inc., The James L. ....                  | Hartford .....                   | 1        | Oct. 21             | 1048                |
| Heath & Co.....                                              | Manchester .....                 | 1        | Sept. 9             | 1002                |
| Hilliard, H. J. ....                                         | Sound View ....                  | 1        | Sept. 2             | 993                 |
| Hiti Nurseries (J. H. Bowditch Prop.) .....                  | Pomfret Center..                 | 5        | Sept. 6             | 996                 |
| Holcomb, Irving .....                                        | Simsbury .....                   | 1        | Sept. 11            | 1007                |



NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Cont'd.*

| Name of Firm.                                             | Address.                       | Acreage. | Certificate Issued. | No. of Certificate. |
|-----------------------------------------------------------|--------------------------------|----------|---------------------|---------------------|
| Horan & Son, Jas.....                                     | Bridgeport .....               | 1        | Nov. 4              | 1053                |
| Houston & Sons, J. R. ....                                | Mansfield .....                | 4        | Sept. 2             | 991                 |
| Hoyt's Sons Co., Inc., The Stephen .....                  | New Canaan ....                | 300      | Oct. 23             | 1049                |
| Hubbard & Co., Paul M.....                                | Bristol .....                  | 12       | Nov. 1              | 1051                |
| Hunt & Co., W. W. ....                                    | Hartford .....                 | 10       | Sept. 15            | 1008                |
| Isselee, Charles .....                                    | Darien .....                   | 10       | Nov. 7              | 1062                |
| Kelley, James J. ....                                     | New Canaan ....                | 1        | Oct. 15             | 1045                |
| Kellner, Herman H. ....                                   | Danbury .....                  | 1        | Oct. 1              | 1024                |
| Keso Nursery (J. J. Kelsey, Prop.)                        | Clinton .....                  | 1        | Sept. 23            | 1014                |
| Laddin's Rock Nursery (W. L. Marks, Prop.) (2) .....      | Stamford .....                 | 5        | Oct. 6              | 1031                |
| Larkin Bros., The.....                                    | New London ....                | 1        | Sept. 6             | 997                 |
| Long, J. A., Mrs.....                                     | East Haven ....                | 1        | Sept. 30            | 1020                |
| Mallett Co., George A.....                                | Bridgeport .....               | 1        | Nov. 3              | 1052                |
| Maplewood Nurseries (T. A. Peabody, Mgr.) .....           | Norwich .....                  | 1        | Sept. 2             | 992                 |
| Marigold Farm (H. Kelley, Prop.)                          | New Canaan ....                | 2        | Sept. 27            | 1019                |
| McDermott, E. F. ....                                     | Windsor .....                  | 1        | Oct. 3              | 1028                |
| Meier & Gillette.....                                     | West Hartford...               | 2        | Nov. 5              | 1056                |
| Munro, Charles .....                                      | New Haven ....                 | 1        | Sept. 30            | 1021                |
| New Haven Nurseries.....                                  | New Haven ....                 | 10       | Oct. 9              | 1038                |
| New Haven Park Commissioners (G. X. Amrhyt, Supt.) .....  | New Haven ....                 | 30       | Oct. 7              | 1033                |
| New London Cemetery Association (Ernest E. Rogers, Pres.) | New London,....                | 1        | Nov. 7              | 1061                |
| New London County Nurseries (W. J. Schoonman, Prop.) (2)  | New London and Stonington .... | 5        | Dec. 9,             | 1069                |
| North-Eastern Forestry Co.....                            | Cheshire .....                 | 20       | Aug. 26             | 988                 |
| Oakland Nurseries .....                                   | Manchester .....               | 1        | Sept. 9             | 1001                |
| Palmer, Est. of L. M. ....                                | Stamford .....                 | 5        | Oct. 1              | 1026                |
| Park Gardens .....                                        | Bridgeport .....               | 1        | Oct. 10             | 1040                |
| Pequod Nursery Co.....                                    | Meriden .....                  | 15       | Sept. 11            | 1004                |
| Phelps, J. Wesson.....                                    | Bolton .....                   | 1        | Sept. 2             | 994                 |
| Phelps & V. T. Hammer Co., The J. W. ....                 | Branford .....                 | 2        | Oct. 21             | 1047                |
| Pierson, A. N., Inc.....                                  | Cromwell .....                 | 50       | Aug. 23             | 987                 |
| Platt, Co., The Frank S. ....                             | New Haven ....                 | 1        | Oct. 7              | 1035                |
| Pomeroy, Edwin C. ....                                    | Northville ....                | 1        | Nov. 6              | 1058                |
| Purinton, Mrs. C. O. ....                                 | Hartford .....                 | 1        | Oct. 6              | 1032                |
| Quality Seed Store .....                                  | Stamford .....                 | 1        | Oct. 4              | 1029                |
| Reck, Julius .....                                        | Bridgeport .....               | 1        | Oct. 10             | 1039                |
| Rockfall Nursery Co. (P. Marotta, Prop.) (2) .....        | Rockfall .....                 | 1        | Nov. 4              | 1054                |

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Conc'd.*

| Name of Firm.                    | Address.         | Acreage. | Certificate Issued. | No. of Certificate. |
|----------------------------------|------------------|----------|---------------------|---------------------|
| Saxe & Floto .....               | Waterbury .....  | 1        | Dec. 2,             | 1068                |
| Schleichert, F. C.....           | Bridgeport ..... | 1        | Oct. 10             | 1041                |
| Scott, J. W.....                 | Hartford .....   | 5        | Nov. 17             | 1067                |
| Sierman, C. H.....               | Hartford .....   | 5        | Oct. 17             | 1046                |
| South Wilton Nurseries.....      | South Wilton ... | 5        | Oct. 9              | 1036                |
| Stannard Hill Greenhouses (J. E. |                  |          |                     |                     |
| Brooks, Prop.) .....             | Westbrook .....  | 1        | Sept. 23            | 1013                |
| Steck, Charles A. ....           | Bethel .....     | 2        | Oct. 9              | 1037                |
| Stratfield Nursery Co.....       | Bridgeport ..... | 4        | Nov. 11             | 1064                |
| Traendly & Schenck.....          | Rowayton .....   | 2        | Oct. 1              | 1027                |
| Upson, R. E.....                 | Marion .....     | 1        | Nov. 6              | 1060                |
| Verkade, H. ....                 | New London ...   | 2        | Sept. 15            | 1009                |
| Vidbourne & Co., J.....          | Hartford .....   | 7        | Oct. 14             | 1043                |
| Wallace, Arthur T.....           | Wallingford ...  | 2        | Oct. 14             | 1044                |
| Wild, Henry .....                | Riverside .....  | 1        | Oct. 4              | 1030                |
| Wilson & Co., C. E.....          | Manchester ..... | 10       | Sept. 9             | 998                 |
| Yale University Forest School..  | New Haven ....   | 1        | Sept. 22            | 1010                |
| Young, Mrs. Nellie A.....        | Pine Orchard ... | 1        | Oct. 1              | 1023                |
| Total acreage .....              |                  | 1,525    |                     |                     |

## INSPECTION OF IMPORTED NURSERY STOCK.

For the past ten years an attempt has been made by this department to inspect all woody nursery stock, entering the state, that had been imported from foreign countries. The establishment of the Federal Horticultural Board in 1912, and its system of permits and notices adopted soon afterward, made it possible to examine a much larger proportion of shipments entering the State. From that time to the present, nearly all shipments have been examined, but of course it is nearly impossible to intercept all pests that might be brought over. Especially is this true of plants like azaleas and rhododendrons and certain conifers which are usually shipped with a ball of earth about the roots. Then, too, certain insects may crawl out of the cases and escape before the stock is unpacked or even during the operation.

There had been a rapid increase each year in the number of shipments of this kind coming to Connecticut until the war. In 1917 and 1918, the number of shipments dropped off markedly on account of the blockade and scarcity of tonnage in shipping.

After the armistice was signed, however, and shipping again resumed, considerable stock was shipped. The Federal Horticultural Board announced an embargo, Quarantine 37, on most kinds of nursery stock and woody field grown florist's stock to take effect June 30, 1919. Certain kinds of stock like seedling fruit and manetti rose, which are used for propagation and which are shipped with roots bare, will still be allowed to enter under the rules and regulations prescribed by the Federal Horticultural Board. There is an arrangement by which new and promising forms and varieties may be imported through the U. S. Department of Agriculture.

The trade evidently tried to bring into the country as much stock as possible before the new restrictive measures went into effect. Consequently between October 1st, 1918, and June 30, 1919, 131 shipments containing 1075 cases and 1,164,701 plants were received in Connecticut and inspected by members of this department. This is nearly twice the number of shipments and nearly three times the number of cases inspected last year, and an increase of 38 per cent in the number of plants. Forty-four shipments or 33.5 per cent were infested with insects or fungi some of which are pests.

Most of this stock was inspected by Messrs. Zappe and Chamberlain, but Messrs. Walden, Davis, and Britton assisted during the rush season. The time required to inspect this stock amounts to 707.5 hours, or 94.3 days of 7½ hours each, or 3.62 months of 26 working days each.

The sources of this stock are given in the following table:—

SOURCES OF IMPORTED NURSERY STOCK, 1918-1919.

| Country.       | No. of Shipments. | No. of Cases. |
|----------------|-------------------|---------------|
| Holland .....  | 98                | 937           |
| France .....   | 14                | 73            |
| England .....  | 8                 | 23            |
| Scotland ..... | 5                 | 5             |
| Ireland .....  | 3                 | 3             |
| Bermuda .....  | 2                 | 32            |
| Japan .....    | 1                 | 2             |
| Total .....    | 131               | 1,075         |

The following table shows the quantity of stock as inspected by months:—



| Month.               | No. of Shipments. | No. of Cases. | No. of Plants. |
|----------------------|-------------------|---------------|----------------|
| December, 1918 ..... | 4                 | 5             | 20,000         |
| January, 1919 .....  | 7                 | 55            | 293,473        |
| February .....       | 19                | 85            | 70,360         |
| March .....          | 9                 | 40            | 157,107        |
| April .....          | 83                | 242           | 588,754        |
| May .....            | 7                 | 40            | 34,999         |
| June .....           | 2                 | 8             | 8              |
| Total .....          | 131               | 1,075         | 1,164,701      |

Notices were received of five additional shipments containing 35 cases which were not inspected. Three of these shipments were reshipped and sent out of the State, one contained only herbaceous stock, and one was unpacked and the plants distributed before it was possible to inspect them.

As was the situation last year, none of these shipments came directly from Italy, Belgium or Germany.

As in former years, most of the insects and fungi found in the shipments are (1) species which are already present in this country or (2) species which are not important as pests. However, there are some exceptions. Among the insects intercepted when the plants were inspected in 1919, are the Brown-tail moth, *Euproctis chrysorrhoea* Linn., regarded as an important pest but already present in the New England states; European tent-caterpillar *Malacosoma neustria* Linn., a pest of trees in Europe, which though several times intercepted on stock brought into this country, is not yet established here; *Agelastica alni* Linn., and *Emphytus cinctus* Linn., also brought in many times but not established here; *Otiorhynchus sulcatus* Fabr., *Coccus hesperidum* Linn., and the oyster-shell scale are already established in this country. The infestations found during the year are given in detail as follows:—

#### PESTS FOUND ON IMPORTED NURSERY STOCK, 1918-1919.

44 Shipments Infested.

*Insects, etc.*

*Agelastica alni* Linn. on trees. Van Gelderen & Co., Boskoop, Holland.  
*Amara communis* Panz. Trees. Koster & Co., Boskoop, Holland.  
*Anisodactylus binotatus* Fabr. Trees. Visser Bros., Naarden, Holland.  
*Aphodius granarius* Linn. on Taxus. Koster & Co., Boskoop, Holland.  
*Barypithes pellucidus* Boh. Taxus trees. Koster & Co., Boskoop, Holland.  
*Carabus nemoralis* Mull. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.

- Clivina fossor* Linn. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.
- Coccinella 7-punctata* Linn. Azaleas. H. M. Hardyzer, Boskoop, Holland.
- Coccus hesperidum* Linn. on laurel trees. Flandria Societe Anonyme, Bruges, Belgium.
- Curculionid larvae. Trees. H. M. Hardyzer, Boskoop, Holland.
- Elaterid larvae on shrubs. H. M. Hardyzer, Boskoop, Holland; Van Heinigen Bros. & Co., Boskoop, Holland.
- Emphytus cinctus* Linn. on Manetti Rose. R. H. Bath, Ltd., Wisbech, England; S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; As. Ouwerkerk, Boskoop, Holland; Thomas Smith & Sons, Troon, Scotland; Louis Leroy Nurseries Co., Angers, France.
- Emphytus cinctus* Linn. larva. E. Turbat & Co., Orleans, France.
- Euproctis chrysorrhoea* Linn. on fruit trees. Franco-American Seedling Co., Nantes, France.
- Falagria* sp. D. Prior & Sons, Colchester, England.
- Forficula auricularia* Linn. on trees. H. M. Hardyzer, Boskoop, Holland.
- Lampyrid larva on Juniper trees. Van Heinigen Bros. & Co., Boskoop, Holland.
- Lathrobium brunnipes* Fabr. on trees. Van Heinigen Bros. & Co., Boskoop, Holland; M. Koster & Sons, Boskoop, Holland.
- Lepidopterous pupa on spruce. M. Koster & Sons, Boskoop, Holland.
- Malacosoma neustria* Linn. on shrubs. Visser Bros., Naarden, Holland.
- Milliped on Manetti Rose. Vincent Lebreton, La Pyramide-Trelaze, France.
- Mycetaea hirta* Mar. D. Prior & Sons, Colchester, England.
- Nest of Rats on blue spruces. Harry Koolbergen, Boskoop, Holland.
- Noctuid cocoon on trees. Franco-American Seedling Co., Nantes, France.
- Pterostichus vulgaris* Linn. In soil. Koster & Co., Boskoop, Holland.
- Otiornhynchus sulcatus* Fabr. Taxus. Van Heiningen Bros. & Co., Boskoop, Holland.
- Oyster Shell Scale on Boxwood. Sliedrecht & Co., Boskoop, Holland; Schaum & Van Tol, Boskoop, Holland; Koster & Co., Boskoop, Holland; Visser Bros., Naarden, Holland; Ebbinge & Van Groos, Boskoop, Holland; Van Heiningen Bros. & Co., Boskoop, Holland; H. den Ouden & Son, Boskoop, Holland; C. Van Kleef & Co., Boskoop, Holland; F. J. Grootendorst & Sons, Boskoop, Holland; W. Van & Sons, Boskoop, Holland; As. Ouwerkerk, Boskoop, Holland.
- Sow bug on shrubs. K. Kromhout & Sons, Boskoop, Holland.
- Spiders eggs, one mass on shrubs. K. Kromhout & Sons, Boskoop, Holland.
- Triana plebeja* Gyllh. on trees. Ebbinge & Van Groos, Boskoop, Holland.

#### Plant Diseases.

- Crown Gall on Manetti Rose. S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; Thomas Smith & Sons, Troon, Scotland; As. Ouwerkerk, Boskoop, Holland; Louis Leroy Nurseries Co., Angers, France.

## INSPECTION OF IMPORTED BULBS.

At the suggestion of the Federal Horticultural Board, an attempt has been made, at least for a definite period, to inspect the imported bulbs entering Connecticut, in order to ascertain whether or not any dangerous pests are liable to be introduced in this way. Bulbs were not prohibited under Quarantine No. 37, and no effort has ever been made before to inspect them in Connecticut. The first to arrive were lily bulbs from Bermuda, then narcissus paper whites from France which began coming in July. Later came tulip and hyacinth bulbs from Holland and lily bulbs from Japan.

The source of the shipments inspected are as follows:—

| Country.      | No. of Shipments. | No. of Cases. |
|---------------|-------------------|---------------|
| France .....  | 104               | 302           |
| Holland ..... | 147               | 436           |
| Japan .....   | 43                | 141           |
| China .....   | 9                 | 26            |
| Bermuda ..... | 4                 | 6             |
| England ..... | 10                | 13            |
| Total .....   | 317               | 924           |

The inspections by months are as follows:—

| Month.          | No. of Shipments. | No. of Cases. | No. of Bulbs. |
|-----------------|-------------------|---------------|---------------|
| July .....      | 1                 | 3             | 200           |
| August .....    | 46                | 102           | 71,900        |
| September ..... | 57                | 199           | 231,835       |
| October .....   | 109               | 334           | 629,495       |
| November .....  | 104               | 286           | 596,345       |
| Total .....     | 317               | 924           | 1,529,775     |

On November 14, notice was received from the Federal Horticultural Board that arrangements had finally been made for these bulbs to be examined at the ports of entry of Boston, New York, Washington, New Orleans, Seattle, Tacoma and San Francisco by Federal inspectors. Consequently, hereafter, at least until further notice, it will not be necessary for us to examine bulbs.

Most of this inspection work has been done by Messrs. Zappe and Chamberlain, but Mr. Davis has inspected those shipments going into the eastern end of the State and Messrs. Lewis, Garman, Stone, Walden and Britton have all helped at times in the work.



In 67 shipments or 21.1 per cent. pests were found, the most common being the bulb mite *Rhizoglyphus hyacinthi* Boisdv., known in Europe as *R. echinopus* Fumouse & Robin, which was found in 39 shipments. Apparently this mite will attack and injure any kind of bulbs, and also some of the stems growing out of them. Another pest found in imported bulbs is the bulb fly *Merodon equestris* Fabr., which was found in 4 shipments. Both the bulb mite and the bulb fly have been brought into this country many times and are no doubt established here.

The time required to inspect these bulbs is equivalent to one man working 847½ hours or 113 days of 7½ hours each, or 4⅓ months of 26 working days each.

The data regarding the infested shipments of bulbs are as follows:—

PESTS FOUND ON IMPORTED BULBS, 1919.

67 Shipments Infested.

*Insects, etc.*

*Atheta* sp. C. J. Speelman & Sons, Holland (1).

Capsid bug. Van Zonneveld Bros. & Philippo, Holland (1).

*Cathartus advena* Wal. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

Elaterid larva in hyacinths. C. J. Speelman & Sons, Sassenheim, Holland (1).

Lepidopterous larvae in buckwheat chaff. L. Van Leeuwen & Son, Holland (5); M. Van Waveren, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1); Baartman & Koning, Sassenheim, Holland (1).

*Merodon equestris* Fabr. L. Van Leeuwen & Son, Sassenheim, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (1); J. Schilpzand & Sons, Hillegem, Holland (1); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (1).

*Pyrallis farinalis* Linn. in buckwheat chaff. L. Van Leeuwen & Son, Sassenheim, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1).

*Rhizoglyphus echinopus* Fumouse and Robin. A. & L. Bremond Freres, Ollioules, France (1); Guldemond & Son, Lisse, Holland (4); Meskers Bros., Holland (1); K. Van Bourgondier & Son, Hillegem, Holland (3); C. Colyn & Son, Voorhout, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (2); J. Schilpzand & Sons, Hillegem, Holland (2); Lagarde & Speelman, Ollioules, France (2); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (5); Vandervooit Alkemade, Naardwyk, Holland (1); L. Van Leeuwen & Son, Island of Guernsey (2); D. Nieuwehuis & Sons, Lisse, Holland (1); C. J. Speelman & Sons, Holland (5); Zangerbergen Bros., Valkenberg, Holland (1); Drevon-Tegelaar & Co., Ollioules, France (1); M. Van Waveren & Sons, Hillegem, Holland (3); Van Meeuwen & Tegelaar, Lisse, Holland (3); Richachiro Tanoi, Yokohama, Japan (1).

*Sitodrepa panicea* Linn. Van Zooneveld Bros. & Philippo, Sassenheim, Holland (1).

Staphylinids in narcissus. Zaubergen Bros., Valkenberg, Holland (1).

*Tenebrio molitor* Linn. in chaff packing. L. Van Leeuwen & Son, Holland (1); C. G. Van Tubergen, Jr., Holland (1).

*Tenebrio* sp. (?) in buckwheat chaff. Van Zooneveld Bros. & Philippo, Holland (2); Baartman & Koning, Sassenheim, Holland (1).

*Typhoea fumata* Linn. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

#### Fungi.

*Papuspora* sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).

*Penicillium* sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).

### INSPECTION OF APIARIES.

There has been no change in the personnel of the inspectors or in the system of inspecting apiaries, during the year; Mr. H. W. Coley of Westport has inspected in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford has inspected in Litchfield, Hartford, Tolland and Windham Counties, each working on a *per diem* basis.

On account of the change in the fiscal year, all work done prior to July 1, 1919, was paid for out of the old appropriation, leaving a balance of \$43.70. The General Assembly increased the appropriation from \$750.00 to \$2000.00 annually, the new and increased appropriation becoming available July 1, 1919. The wages of the inspectors were increased July 1 from four to five dollars per day, which accounts in part for the increased cost of inspection per apiary and per colony, over former years. The report of the inspection work for the entire season is contained in this paper.

The General Assembly at the request of the Connecticut Beekeepers Association enacted a law, requiring beekeepers to register with the town clerks of their respective towns, as follows:—

#### CHAPTER 174, PUBLIC ACTS OF 1919.

An Act concerning Registration of the Owners of Honey Bees.  
*Be it enacted by the Senate and House of Representatives in General Assembly convened:*

Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such

bees, and such town clerk shall issue to such applicant a certificate of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

Sec. 2. A record of such registration with the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be recorded in a separate book in the office of the town clerk, which records shall be accessible to the public.

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars.

Approved, May 1, 1919.

This law will enable the inspectors to find the apiaries, so that in localities where diseases occur, it will be much easier to eradicate them.

During the season, 723 apiaries, containing 6,070 colonies, were inspected. The record for 1918 was 385 apiaries, and 2,913 colonies. In making these inspections, 102 towns were visited as against 83 last year. Inspections were made in the following towns which were not visited last year:

Fairfield County—Bridgeport.

New Haven County—Branford, Cheshire, Guilford, Hamden, Meriden, Oxford and Wolcott.

Middlesex County—Durham, East Haddam, East Hampton, Killingworth, Middletown, Portland, Saybrook and Westbrook.

New London County—Lisbon, Stonington and Groton.

Litchfield County—Bethlehem, Harwinton, Thomaston, Torrington, Warren and Washington.

Hartford County—Avon, East Hartford, Glastonbury, Granby, Manchester, Marlborough, Rocky Hill, Southington, West Hartford, Wethersfield and Windsor.

Tolland County—Andover, Bolton and Tolland.

Windham County—Brooklyn, Putnam, Thompson and Woodstock.

On the other hand, several towns in which inspections were made in 1918 were not visited this year. These are as follows:—

Fairfield County—Trumbull.

New Haven County—Ansonia.

Litchfield County—Colebrook, Cornwall, Goshen, Kent, New Hartford, Norfolk, Canaan, Salisbury, Sharon and Winchester.

Tolland County—Columbia, Ellington and Somers.

Windham County—Ashford, Canterbury and Chaplin.



In Avon, Oxford, Saybrook and Westbrook no inspections had ever been made until 1919. There still remain twelve towns where inspections have never been made, as follows: Tolland County, Union; Windham County, Eastford; Fairfield County, Sherman and New Fairfield; New Haven County, East Haven; Middlesex County, Essex, Chester, Middlefield and Old Saybrook; New London County, Lebanon, Preston and Voluntown. An effort will be made to inspect some of the apiaries in these towns next year.

The inspections made during 1919 show that the European foul brood continues to decrease as has been the case each year for the past ten years since the inspection service began. In 1910 when the first inspections were made, 75.9 per cent of the apiaries and 49.7 per cent of the colonies had European foul brood. In 1919, the infestation was only 6.6 per cent of the apiaries, and 1.2 per cent of the colonies. During the past season European foul brood was found in the following 34 towns:—Fairfield County, Bridgeport, Norwalk, Redding and Stamford; New Haven County, Cheshire and Wolcott; Middlesex County, Durham; New London County, Norwich and Old Lyme; Litchfield County, Bethlehem, Bridgewater, Thomaston, Torrington, and Watertown; Hartford County, East Hartford, Farmington, Glastonbury, Granby, Manchester, Marlborough, New Britain, Plainville, West Hartford, Wethersfield, Windsor and Windsor Locks; Tolland County, Coventry and Vernon; Windham County, Brooklyn, Killingly, Pomfret, Scotland, Sterling and Windham.

American foul brood was first found by the inspectors in 1914, and since then in two or three places each year, but the percentage of apiaries infested has never been much above one per cent, or of colonies one-third of one per cent, until 1919, when 3.0 per cent of the apiaries and 1.1 per cent of the colonies were found infested. The disease, therefore, has been more prevalent and infests a higher percentage of apiaries than ever before. One of the principal centers of infestation was Wallingford, where twenty-seven colonies in eleven apiaries were found diseased. It was also present in the following eight towns;—Stamford, Shelton (Huntington), Wallingford, Madison, Killingworth, East Lyme, Waterford and East Hampton. These towns are all in

Mr. Coley's territory in the southern half of the State, and must be given particular attention next year.

The statistics of the apiaries examined in 1919 in each of the 102 towns are given by counties in the following tables, the summary occurring on page 134.

## APIARIES INSPECTED IN 1919.

|                       | No. Apiaries |           | No. Colonies |           |
|-----------------------|--------------|-----------|--------------|-----------|
|                       | Inspected.   | Diseased. | Inspected.   | Diseased. |
| Fairfield County:     |              |           |              |           |
| Bethel .....          | 2            | 0         | 5            | 0         |
| Bridgeport .....      | 4            | 1         | 100          | 2†        |
| Danbury .....         | 9            | 0         | 90           | 0         |
| Darien .....          | 3            | 1         | 26           | 1§        |
| Easton .....          | 2            | 1         | 86           | 1§        |
| Fairfield .....       | 9            | 0         | 193          | 0         |
| Greenwich .....       | 12           | 0         | 166          | 0         |
| Huntington .....      | 1            | 1         | 3            | 1*        |
| Monroe .....          | 1            | 0         | 2            | 0         |
| New Canaan .....      | 5            | 1         | 37           | 1†        |
| Norwalk .....         | 10           | 2         | 97           | 5†        |
| Redding .....         | 6            | 0         | 64           | 0         |
| Ridgefield .....      | 7            | 0         | 69           | 0         |
| Stamford .....        | 21           | 6         | 230          | 7‡        |
| Stratford .....       | 2            | 0         | 63           | 0         |
| Westport-Weston ..... | 10           | 0         | 120          | 0         |
| Wilton .....          | 13           | 0         | 156          | 0         |
|                       | 117          | 13        | 1,515        | 18        |
| New Haven County:     |              |           |              |           |
| Beacon Falls .....    | 1            | 0         | 28           | 0         |
| Branford .....        | 5            | 1         | 41           | 4§        |
| Cheshire .....        | 7            | 1         | 58           | 1†        |
| Derby .....           | 2            | 0         | 47           | 0         |
| Guilford .....        | 3            | 1         | 34           | 5         |
| Hamden .....          | 7            | 1         | 28           | 1†        |
| Madison .....         | 7            | 2         | 29           | 2*§       |
| Meriden .....         | 18           | 0         | 146          | 0         |
| Middlebury .....      | 1            | 0         | 34           | 0         |
| Milford .....         | 1            | 0         | 52           | 0         |
| Naugatuck .....       | 6            | 0         | 37           | 0         |
| New Haven .....       | 3            | 0         | 28           | 0         |

\* American Foul Brood.

† European Foul Brood.

‡ 2 American Foul Brood, 1 European Foul Brood and 4 Sacbrood.

§ Sacbrood.

|| Paralysis.

|                    | No. Apiaries |           | No. Colonies |           |
|--------------------|--------------|-----------|--------------|-----------|
|                    | Inspected.   | Diseased. | Inspected.   | Diseased. |
| Oxford .....       | 3            | 0         | 25           | 0         |
| Prospect .....     | 6            | 0         | 53           | 0         |
| Seymour .....      | 2            | 0         | 26           | 0         |
| Wallingford .....  | 20           | 11        | 155          | 27*       |
| Waterbury .....    | 6            | 0         | 26           | 0         |
| Wolcott .....      | 2            | 1         | 14           | 1†        |
|                    | <hr/> 100    | <hr/> 18  | <hr/> 861    | <hr/> 41  |
| Middlesex County:  |              |           |              |           |
| Durham .....       | 5            | 3         | 114          | 11¶       |
| East Haddam .....  | 4            | 0         | 47           | 0         |
| East Hampton ..... | 3            | 1         | 36           | 4*        |
| Killingworth ..... | 2            | 1         | 11           | 2*        |
| Middletown .....   | 1            | 0         | 31           | 0         |
| Portland .....     | 3            | 0         | 30           | 0         |
| Saybrook .....     | 2            | 0         | 20           | 0         |
| Westbrook .....    | 1            | 0         | 8            | 0         |
|                    | <hr/> 21     | <hr/> 5   | <hr/> 297    | <hr/> 17  |
| New London County: |              |           |              |           |
| East Lyme .....    | 5            | 3         | 69           | 5*        |
| Groton .....       | 4            | 0         | 6            | 0         |
| Lisbon .....       | 1            | 0         | 8            | 0         |
| Montville .....    | 6            | 0         | 42           | 0         |
| New London .....   | 3            | 0         | 42           | 0         |
| Norwich .....      | 9            | 1         | 106          | 1†        |
| Old Lyme .....     | 2            | 1         | 53           | 2†        |
| Stonington .....   | 1            | 1         | 20           | 2         |
| Waterford .....    | 5            | 2         | 46           | 18*       |
|                    | <hr/> 36     | <hr/> 8   | <hr/> 392    | <hr/> 28  |
| Litchfield County: |              |           |              |           |
| Bethlehem .....    | 3            | 1         | 3            | 1†        |
| Bridgewater .....  | 9            | 1         | 65           | 1†        |
| Harwinton .....    | 2            | 0         | 7            | 0         |
| Litchfield .....   | 13           | 0         | 153          | 0         |
| New Milford .....  | 8            | 0         | 79           | 0         |
| Plymouth .....     | 7            | 0         | 19           | 0         |
| Thomaston .....    | 8            | 1         | 49           | 1†        |
| Torrington .....   | 7            | 1         | 133          | 1†        |
| Warren .....       | 4            | 0         | 31           | 0         |

\* American Foul Brood.

† European Foul Brood.

¶ 10 American Foul Brood, 1 European Foul Brood.

|| Paralysis.



|                     | No. Apiaries |           | No. Colonies |           |
|---------------------|--------------|-----------|--------------|-----------|
|                     | Inspected.   | Diseased. | Inspected.   | Diseased. |
| Watertown .....     | 6            | 3         | 57           | 3†        |
| Washington .....    | 4            | 0         | 137          | 0         |
|                     | <u>71</u>    | <u>7</u>  | <u>733</u>   | <u>7</u>  |
| Hartford County:    |              |           |              |           |
| Avon .....          | 2            | 0         | 13           | 0         |
| Berlin .....        | 7            | 0         | 75           | 0         |
| Bloomfield .....    | 2            | 0         | 159          | 0         |
| Bristol .....       | 11           | 0         | 100          | 0         |
| Burlington .....    | 10           | 0         | 54           | 0         |
| Canton .....        | 15           | 0         | 67           | 0         |
| East Granby .....   | 3            | 0         | 19           | 0         |
| East Hartford ..... | 15           | 1         | 95           | 2†        |
| East Windsor .....  | 9            | 0         | 98           | 0         |
| Enfield .....       | 8            | 0         | 39           | 0         |
| Farmington .....    | 21           | 1         | 98           | 1†        |
| Glastonbury .....   | 27           | 4         | 119          | 9†        |
| Granby .....        | 4            | 1         | 48           | 1†        |
| Hartford .....      | 24           | 1         | 99           | 1         |
| Manchester .....    | 14           | 1         | 87           | 1†        |
| Marlborough .....   | 2            | 1         | 46           | 3†        |
| New Britain .....   | 9            | 1         | 100          | 6†        |
| Newington .....     | 4            | 0         | 50           | 0         |
| Plainville .....    | 10           | 3         | 31           | 9†        |
| Rocky Hill .....    | 3            | 0         | 24           | 0         |
| Southington .....   | 5            | 0         | 14           | 0         |
| South Windsor ..... | 8            | 0         | 32           | 0         |
| Suffield .....      | 9            | 0         | 34           | 0         |
| West Hartford ..... | 25           | 1         | 117          | 2†        |
| Wethersfield .....  | 11           | 2         | 55           | 3†        |
| Windsor .....       | 11           | 2         | 28           | 2†§       |
| Windsor Locks ..... | 4            | 2         | 13           | 2†        |
|                     | <u>273</u>   | <u>21</u> | <u>1,714</u> | <u>42</u> |
| Tolland County:     |              |           |              |           |
| Andover .....       | 3            | 0         | 21           | 0         |
| Bolton .....        | 5            | 0         | 16           | 0         |
| Coventry .....      | 11           | 1         | 59           | 1†        |
| Mansfield .....     | 5            | 0         | 41           | 0         |
| Stafford .....      | 3            | 0         | 23           | 0         |
| Tolland .....       | 2            | 0         | 4            | 0         |
| Vernon .....        | 8            | 1         | 40           | 2†        |
| Willington .....    | 11           | 0         | 33           | 0         |
|                     | <u>48</u>    | <u>2</u>  | <u>237</u>   | <u>3</u>  |

† European Foul Brood.

§ Sacbrood.

|| Paralysis.

|                  | No. Apiaries |           | No. Colonies |           |
|------------------|--------------|-----------|--------------|-----------|
|                  | Inspected.   | Diseased. | Inspected.   | Diseased. |
| Windham County:  |              |           |              |           |
| Brooklyn .....   | 1            | 1         | 2            | 1†        |
| Killingly .....  | 6            | 2         | 32           | 3†        |
| Plainfield ..... | 8            | 0         | 43           | 0         |
| Pomfret .....    | 15           | 1         | 94           | 2†        |
| Putnam .....     | 2            | 0         | 11           | 0         |
| Scotland .....   | 5            | 2         | 47           | 2†        |
| Sterling .....   | 2            | 1         | 9            | 2†        |
| Thompson .....   | 2            | 0         | 20           | 0         |
| Windham .....    | 15           | 1         | 58           | 1†        |
| Woodstock .....  | 1            | 0         | 5            | 0         |
|                  | 57           | 8         | 321          | 11        |

## SUMMARY.

| County           | No. of Towns | No. Apiaries |          | No. Colonies |          |
|------------------|--------------|--------------|----------|--------------|----------|
|                  |              | Inspected    | Diseased | Inspected    | Diseased |
| Fairfield .....  | 18           | 117          | 13       | 1,515        | 18       |
| New Haven .....  | 17           | 100          | 18       | 861          | 41       |
| Middlesex .....  | 6            | 21           | 5        | 297          | 17       |
| New London ..... | 9            | 36           | 8        | 392          | 28       |
| Litchfield ..... | 11           | 71           | 7        | 733          | 7        |
| Hartford .....   | 26           | 273          | 21       | 1,714        | 42       |
| Tolland .....    | 8            | 48           | 2        | 237          | 3        |
| Windham .....    | 10           | 57           | 8        | 321          | 11       |
|                  | 105          | 723          | 82       | 6,070        | 167      |

|                                          | No. Apiaries | No. Colonies |
|------------------------------------------|--------------|--------------|
| Inspected .....                          | 723          | 6,070        |
| Infested with European foul brood .....  | 48           | 78           |
| Per cent. infested .....                 | 6.6          | 1.2          |
| Infested with American foul brood .....  | 22           | 69           |
| Per cent. infested .....                 | 3.0          | 1.1          |
| Sachbrood .....                          | 9            | 12           |
| Pee paralysis .....                      | 3            | 8            |
| Average number of colonies per apiary... |              | 11.2         |
| Cost of inspection .....                 |              | \$1,771.03   |
| Average cost per apiary .....            |              | \$2.45       |
| Average cost per colony .....            |              | .29          |

† European foul brood.

GIPSY AND BROWN-TAIL MOTH WORK  
IN 1919.

BY IRVING W. DAVIS.\*

*Assistant and Deputy in Charge of Moth Work.*

This work has been conducted as in preceding years, in co-operation with the Federal Bureau of Entomology. Apparently there has been no marked wind-spread of the gipsy moth since 1916, consequently the results of careful and persistent efforts show a rather decided decrease in both the number of infestations and number of egg-clusters in the towns now infested. Moreover, in eight towns considered as infested in 1918, no infestations were found by the Federal Scouts. In seven of these and in three others,—making ten altogether, the quarantine has been removed.

The last session of the General Assembly increased the appropriation for suppressing the gipsy and brown-tail moths, and for inspecting imported nursery stock, to \$70,000.00 for the biennial period ending June 30, 1921. The appropriation for similar work for the preceding biennial period was \$40,000.00.

PRESENT STATUS OF THE BROWN-TAIL MOTH  
IN CONNECTICUT.

For the last three or four years, the brown-tail moth has been very scarce in Connecticut, due it is believed to natural enemies, or at least to natural causes. Consequently it has not seemed advisable for the state to attempt to carry out any control measures, or to order municipalities to take action in the matter. The Report of this Station for 1918, page 286, explains how the number of towns quarantined on account of this insect was reduced from seventy-one in 1915 to thirty-one in 1918. The number was further reduced to twenty-one the past year by the release of the following ten towns:—Stafford, Willington, Ashford, Mansfield, Windham, Franklin, Sprague, Bozrah, Norwich and Preston.

A close watch for winter nests was kept by State men when they were travelling about the State on other work, and likewise

\* Note:—Mr. Davis returned January 15, 1919 from service in the U. S. Marine Corps, and since then has been in immediate charge of all field operations. During his absence, Mr. John T. Ashworth served acceptably as Superintendent.—W. E. Britton.



for adult moths around lights during the period of their flight in July. Very few of either were noticed. The Federal Scouts, however, found a few nests in Stonington near the Groton town line in the spring. These were sent to the laboratory at Melrose Highlands, for the purpose of recovering parasites.

## FINANCIAL STATEMENT.\*

## RECEIPTS.

|                                                              |             |
|--------------------------------------------------------------|-------------|
| Appropriation for biennial period ending Sept. 30, 1919..... | \$40,000.00 |
| Transfer by Board of Control .....                           | 103.97      |
| Total Receipts for biennial period .....                     | \$40,103.97 |
| Amount expended, year ending Sept. 30, 1918 .....            | 22,644.18   |
| Balance .....                                                | \$17,459.79 |

## CLASSIFIED EXPENDITURES FOR THE NINE MONTHS ENDING JUNE 30, 1919.

## Salaries and Wages:

|                                            |           |             |
|--------------------------------------------|-----------|-------------|
| I. W. Davis† .....                         | \$ 962.50 |             |
| J. T. Ashworth .....                       | 925.00    |             |
| J. A. McEvoy .....                         | 825.44    |             |
| F. C. Rich .....                           | 827.26    |             |
| E. A. Smith .....                          | 648.45    |             |
| R. G. Newton .....                         | 509.34    |             |
| D. LaBelle .....                           | 708.06    |             |
| H. L. Bodo .....                           | 709.63    |             |
| J. W. Longo .....                          | 429.35    |             |
| K. E. Buffington .....                     | 443.30    |             |
| Other labor .....                          | 3,383.17  | \$10,371.50 |
| Printing and illustrations .....           |           | 6.50        |
| Postage .....                              |           | 6.27        |
| Stationery .....                           |           | .20         |
| Telegraph and Telephone .....              |           | 46.73       |
| Office Supplies .....                      |           | 53.80       |
| Express, Freight and Cartage .....         |           | 285.94      |
| Machinery, Tools and Supplies .....        |           | 3,200.22    |
| Insurance .....                            |           | 389.26      |
| Rental and Storage .....                   |           | 127.00      |
| Traveling Expenses .....                   |           | 1,004.40    |
| Automobile Tires and Repairs .....         |           | 1,272.28    |
| Inspection of Imported Nursery Stock ..... |           | 665.69      |
| Miscellaneous .....                        |           | 30.00       |
| Total .....                                |           | \$17,459.79 |

\* The General Assembly at its last session changed the time of beginning the fiscal year from Oct. 1st to July 1st. Hence the classified expenditures cover only nine months.

† For six and one-half months.

## DETAILS OF GIPSY MOTH WORK BY TOWNS.

The following pages give a detailed account of the work in each of the infested towns:—

## THOMPSON—86 Infestations—2448 Egg-clusters.

In the report of last year a decrease was noted in the number of gipsy moth colonies in Thompson, and it was explained that this was partly due to the fact that single egg-clusters were not counted as infestations. The same practice was followed this year and resulted in finding only eighty-six colonies, as compared with two hundred and seventy-five for the preceding year. These colonies were mostly in the central and eastern portion of the town, there being comparatively few found to the west of the New London and Worcester branch of the N. Y., N. H., and H. R. R. The colonies themselves were smaller than in some of the previous years, the largest containing less than one hundred egg-clusters. In many cases however the egg-clusters were scattered over a large area which made control measures difficult. During the early part of the spring a good deal of undergrowth was cut near many of the colonies, to make the control measures more effective. The larger infestations were also given special attention as were also those which were so located as to make spraying impracticable. Following this the colonies in windswept localities, from which there was great danger of spread of caterpillars, were banded with raupenleim. In the course of the spraying season, both the horse-drawn and automobile truck power sprayers were used in this town, and sixty-seven of the eighty-six colonies were sprayed.

## WOODSTOCK—36 Infestations—876 Egg-clusters.

This town was the first one scouted this year, due to the fact that the western portion was not covered in the scouting of a year ago. It was expected that the western section would contain the majority of the colonies and exactly half of those found in Woodstock were located there near Woodstock Valley and from there south to the Eastford line. The northwestern section did not contain any colonies, and the remaining eighteen were scattered throughout the eastern part of the town. In several cases but one tree was infested and wherever possible these trees were cut and burned. A few of the woodland colonies were also

cleaned of undergrowth and as in Thompson the banding of trees was practised on all colonies in windswept locations. During the month of June, twenty-two of the colonies were sprayed with arsenate of lead, and the patrolling work later indicated a successful season.

#### UNION—1 Infestation—1 Egg-cluster.

The scouting for the gipsy moth in Union during the past winter was done by the Federal men. The town was only partly scouted and the result was the finding of a single egg-cluster.

#### PUTNAM—28 Infestations—777 Egg-clusters.

The gipsy moth colonies in Putnam were well scattered throughout the town, with the exception of one group which was found on the road leading north from East Putnam. Five infestations were located in this vicinity, but none were of a serious nature. The largest colony found was on the Torrey farm in the eastern part of the town. This colony, consisting of 359 egg-clusters, was found on a wooded hillside about 200 yards back from the road. The egg-clusters were scattered over ten acres, which naturally made this colony a difficult one to handle. During the spring a large part of this area was cleaned and the brush burned. This infestation was sprayed in the early part of June, and but few living caterpillars were found. The work of cleaning up the colonies was carried on at seven infestations in Putnam and twenty-six infestations were sprayed.

#### POMFRET—29 Infestations—314 Egg-clusters.

The twenty-nine infestations found in Pomfret were scattered throughout its entire area, but none of these were large, or in any way of a serious nature. The largest colony found was in the southeastern part of the town on land owned by Mr. Fayette L. Wright. This colony was in a large oak and stone wall and contained sixty-six egg-clusters, thirty-two of which were old ones. The undergrowth near this was cut and burned, and the remaining foliage was sprayed later in the season. Another important colony was found in the woodland near the Eastford town line. While this infestation contained only nineteen egg-clusters, these were so widely scattered that it made control measures difficult. This colony was sprayed during June as were also eleven others in this town.

## EASTFORD—21 Infestations—173 Egg-clusters.

This town was scouted by the Federal men, and resulted in locating twenty-one infestations containing 173 egg-clusters. There were no colonies found in the extreme northern portion of the town, but in the south and central sections the infestations were well distributed. The most dangerous colony was found on land of Mr. Andrew Chilkott about a mile to the west of Eastford village. The growth here was largely oak and maple, and the egg-clusters were scattered over a considerable area of it. Its location together with the large area it covered rendered it impossible to do any banding, but this entire tract of woodland was sprayed. Another infestation of note was on land of Mr. John Fitts near the Ashford line. This was also in the woodland, but was not scattered as much as the former colony. It was also sprayed during June. Altogether ten of the infestations in Eastford were sprayed and five were cleaned of the undergrowth.

## ASHFORD—1 Infestation—1 Egg-cluster.

Mr. H. L. McIntyre of the Federal force found a single egg-cluster of the gipsy moth in Ashford. This was sent to the Government Parasite Laboratory in Melrose Highlands, Mass., and the report from there stated that this egg-cluster was infertile.

## KILLINGLY—27 Infestations—755 Egg-clusters.

The twenty-seven colonies of the gipsy moth found in this town were widely scattered, and none of them were considered of a serious nature. Among the larger colonies might be mentioned two which were in the northwestern part of the town and near the state road leading to Putnam. One of them was in two large pasture oaks and 107 egg-clusters were creosoted on these trees. The other colony, a short distance south of the first, was in an old apple tree. This tree was cut, and in the course of cleaning it up 118 egg-clusters were found and destroyed. In the course of scouting for larvae several egg-clusters were found and during June these areas were sprayed making in all thirty-eight different localities in Killingly which were sprayed this year.

## BROOKLYN—16 Infestations—1433 Egg-clusters.

During the scouting this past winter, sixteen colonies of the gipsy moth were located here principally in the eastern and southern portions of the town, and among them were some of



the largest colonies found this season. One infestation worthy of note was found on land of Mr. DeMott in the eastern part of the town near the Killingly line. While there were 796 egg-clusters here, the growth was very small consisting of one or two small oak trees. This colony was sprayed early in the season with a hand-sprayer and from later observations it is believed that the colony has been exterminated. Another large colony was found in a maple swamp in the northern part of the town. This infestation was scattered over a large area and was so located that it was not feasible to spray it. The most dangerous colonies in this town were cleaned of undergrowth and during the month of June, fourteen of the colonies were sprayed with arsenate of lead.

#### HAMPTON—12 Infestations—30 Egg-clusters.

There were very few egg-clusters of the gipsy moth found in Hampton this year as compared with last, when 336 egg-clusters were destroyed. The colonies also were small; the largest containing only seven egg-clusters, and located around the borders of the town while in the central portion none were found. Five of them contained but a single egg-cluster each, and none of them were serious enough to warrant spraying.

#### MANSFIELD—1 Infestation—1 Egg-cluster.

Mansfield was scouted by the Federal men and their work consisted largely of scouting around the colonies of the previous year. Only one egg-cluster was found near one of these infestations.

#### STERLING—10 Infestations—216 Egg-clusters.

Sterling was first found infested by the gipsy moth in the winter of 1914-15. Scattering colonies were located during the next two years, but in 1917 a general infestation occurred. The result of the scouting this winter was the finding of ten colonies and several single egg-clusters. Most of the colonies were in the northern section of the town, a few were in the extreme southern portion, leaving an area in the central part where but few traces of the moth were found. The largest colony in the town contained forty-nine egg-clusters in the village of Oneco. This was on the eastern slope of a small hill and the egg-clusters were found in some oaks and a nearby stone wall. The presence of a lot of rubbish and undergrowth made cleaning necessary

and this colony was later sprayed. Other colonies of importance include one of thirty-two egg-clusters found in an abandoned orchard near the Killingly line, and one in the extreme southern part of the town on land of Addie Fenner. These colonies together with four others were sprayed during June.

PLAINFIELD—18 Infestations—756 Egg-clusters.

In this town the infestations were almost all rather large, three of them containing over 100 egg-clusters each. Two of these were in the north part of the town, and one in the south part near the Griswold line. These were all in orchards, which made control measures rather easy. No cleaning was necessary, but all three were sprayed. Several of the colonies in this town were found in pasture oaks. In such cases the nearby brush was cut and burned and wherever possible the infestation was later sprayed. The Federal sprayer was used in this town, and twelve of the colonies were sprayed.

CANTERBURY—10 Infestations—248 Egg-clusters.

Only ten infestations were found as the result of scouting Canterbury this past winter. These may be roughly located in three groups, one in the south part of the town in the vicinity of South Canterbury, another in the central part near Canterbury Plains, and the third in the northwestern corner near the Hamp-ton line. The largest colony was found in an apple tree in the south part of the town. Fifty-eight egg-clusters were found when this tree was cut and as it together with the nearby brush was burned, it was not thought necessary to spray this infestation. In all, five colonies were considered serious enough to spray and in Canterbury this was accomplished by the Federal truck during the early part of June.

SCOTLAND—1 Infestation—3 Egg-clusters.

During the winter of 1917-18 seven infestations containing 136 egg-clusters were located in this town. This year but a single infestation was found and that contained only three egg-clusters. This was not sprayed, as it was not thought to be of sufficient importance.

VOLUNTOWN—3 Infestations—81 Egg-clusters.

Three infestations were found in Voluntown this year, all in the northern part of the town. All were located in apple trees,

and during April all were banded with raupenleim. One colony found on land of Sarah Greene contained seventy-five egg-clusters. Several larvae were found here in the early part of June and during the latter part of the month this infestation was sprayed with arsenate of lead.

#### GRISWOLD—8 Infestations—16 Egg-clusters.

The gipsy moth colonies in Griswold were all within a small area in the northeastern corner of the town. These colonies were all small and did not require much attention. In the course of the spraying work gipsy moth caterpillars were found at two places on the State road leading from Jewett City to Plainfield. Both of these were sprayed and the finding of several dead larvae a few days later indicated that the work had been effective.

#### LISBON—1 Infestation—3 Egg-clusters.

Lisbon was scouted by the Federal men during the past winter and only one infestation, containing three egg-clusters, was found.

#### NORWICH—1 Infestation—11 Egg-clusters.

One colony of eleven egg-clusters was found in the western part of Norwich near the Bozrah line. These were removed and sent to the Government Laboratory and it was later reported that all were infertile.

#### NORTH STONINGTON—1 Infestation—1 Egg-cluster.

In this town only one egg-cluster was found, and that near an infestation of the preceding year.

#### LEDYARD—1 Infestation—11 Egg-clusters.

The Federal men scouted this town, and found one colony which contained eleven egg-clusters. This colony was visited by the State men early in the season and as it was in a young apple orchard, the control was easily accomplished.

The following eight towns were scouted by the Federal men and no signs of the gipsy moth were found:

|          |            |
|----------|------------|
| Chaplin  | Preston    |
| Windham  | Sprague    |
| Franklin | Groton     |
| Bozrah   | Stonington |

The recent quarantine maps issued by the Government show that ten Connecticut towns have been removed from the area quarantined on account of the gipsy moth, namely:

Ashford  
Mansfield  
Windham  
Franklin  
Sprague

Bozrah  
Norwich  
Preston  
Groton  
Stonington

The last two—Groton and Stonington—are still quarantined on account of the brown-tail moth.

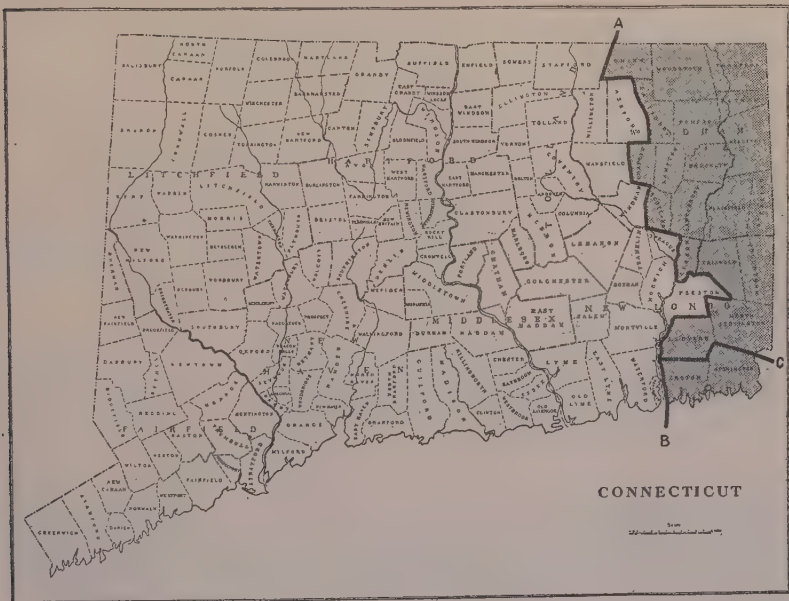


Figure 16. Map of Connecticut showing areas infested by gipsy and brown-tail moths. All territory east of the line A B is quarantined on account of the brown-tail moth. All territory east of the line A C is quarantined because of the gipsy moth.

The Connecticut territory now under Federal quarantine on account of the gipsy moth and the brown-tail moth, includes nineteen towns for the gipsy moth and twenty-one for the brown-tail moth, as shown on the map in figure 16.



## STATISTICS OF INFESTATIONS.

The following table summarizes the work by towns:—

|                        | No. of<br>Infestations | No. of<br>Egg Clusters<br>Destroyed | No. of<br>Bands<br>Applied | No. of<br>Infestations<br>Sprayed | No. of<br>Larvae<br>Destroyed |
|------------------------|------------------------|-------------------------------------|----------------------------|-----------------------------------|-------------------------------|
| Thompson .....         | 86                     | 2,448                               | 221                        | 67                                | 2,881                         |
| Woodstock .....        | 36                     | 876                                 | 173                        | 22                                | ....                          |
| Putnam .....           | 28                     | 777                                 | 219                        | 22                                | 1,564                         |
| Pomfret .....          | 29                     | 314                                 | 35                         | 12                                | ....                          |
| Eastford .....         | 21                     | 163                                 | 36                         | 10                                | ....                          |
| Killingly .....        | 27                     | 755                                 | 399                        | 38                                | 5,988                         |
| Brooklyn .....         | 16                     | 1,433                               | 246                        | 14                                | 887                           |
| Hampton .....          | 12                     | 29                                  | 241                        | 0                                 | ....                          |
| Chaplin .....          | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Mansfield .....        | 1                      | 1                                   | ....                       | 0                                 | ....                          |
| Sterling .....         | 10                     | 216                                 | 362                        | 7                                 | 337                           |
| Plainfield .....       | 18                     | 756                                 | 492                        | 12                                | 529                           |
| Canterbury .....       | 10                     | 248                                 | 349                        | 5                                 | 2                             |
| Scotland .....         | 1                      | 3                                   | ....                       | 0                                 | ....                          |
| Windham .....          | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Ashford .....          | 1                      | 1*                                  | ....                       | 0                                 | ....                          |
| Union .....            | 1                      | 1                                   | ....                       | 0                                 | ....                          |
| Voluntown .....        | 3                      | 81                                  | 86                         | 1                                 | ....                          |
| Griswold .....         | 8                      | 16                                  | 185                        | 2                                 | ....                          |
| Lisbon .....           | 1                      | 3                                   | ....                       | 0                                 | ....                          |
| Sprague .....          | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| North Stonington ..... | 1                      | 1                                   | ....                       | 0                                 | ....                          |
| Preston .....          | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Norwich .....          | 1                      | 11*                                 | ....                       | 0                                 | ....                          |
| Ledyard .....          | 1                      | 11                                  | ....                       | 0                                 | ....                          |
| Stonington .....       | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Groton .....           | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Bozrah .....           | 0                      | 0                                   | ....                       | 0                                 | ....                          |
| Franklin .....         | 0                      | 0                                   | ....                       | 0                                 | ....                          |
|                        | 312                    | 8,144                               | 3,044                      | 212                               | 12,188                        |

## THE WHITE PINE WEEVIL.

*Pissodes strobi* Peck.

Notwithstanding the injury caused by the pine bark aphid, the white pine-currant blister rust and various other pests, it may be stated without fear of contradiction that the weevil causes more damage to young white pines in Connecticut than any of them and possibly more than all of them together.

\* Egg-clusters infertile.

As no comprehensive account of this insect has ever appeared in the reports of this Station, and as frequent requests for information are received and supplied, it is desirable that the facts be brought together in available printed form for the use of the large and increasing number of owners of white pine plantations.

The insect causing this injury is a small brown snout beetle often called weevil or *Curculio* belonging to the family *Curculionidae* of the order *Coleoptera*. It was described in the *Massachusetts Repository and Journal* of January 1817, by Professor W. D. Peck of Harvard University. This paper by Peck is believed to be the first in which an American injurious insect was described.

Thus for more than a hundred years, this weevil has continued to ravage the plantations and natural seedings of white pines in the Northeastern States, and though it seldom kills the trees, it deforms them making them unfit for timber and greatly checks the total or acreage growth.

Ever since the publication of the description of this insect by Peck in 1817, the white pine weevil has been recognized as one of the most injurious pests of pine plantations in this part of the country. It attacks young trees between three and twelve feet in height chiefly, killing the leader or topmost shoot and causing the trunks to become crooked and illshaped. After a tree reaches a height of twelve to fifteen feet, though sometimes weeviled, it is not injured so seriously, but in many cases it takes a long time for the tree to reach that height.

#### EVIDENCE OF INJURY.

The first evidences of attack are small clear drops of pitch which ooze out from the punctures on the bark of the leader or topmost shoot. Later this pitch dries to whitish spots and in some cases runs down the stem. This oozing out of pitch may not be very conspicuous, however, and as a rule the owner does not notice anything the matter with his pines until the leaders begin to wilt and droop, usually during the month of July. In Connecticut this first shows early in the month but there are some trees which do not show it until later. The wilted and drooping leaders soon turn brown and die as is shown on plate IX.

Usually the attacks of the insect are confined to the leaders or topmost shoot, but occasionally lateral branches are weeviled,

and rarely weevils are found below the whorl of branches in two-year-old wood. Normally the weevils attack only wood of the previous season's growth.

White pine is the common host and the only forest tree in Connecticut seriously injured by *Pissodes strobi*, though this weevil is recorded as occasionally attacking other pines, and certain kinds of spruces. Small spruces in nurseries (chiefly Norway spruce) are commonly injured by this weevil. There are also other species of *Pissodes* which are found on some of the pines and spruces: for instance *Pissodes approximatus* Hopkins was reared from the thick bark of *Pinus resinosa*, attacking the old wood even down to the ground. Then *Pissodes affinis* Randall breeds in the thick bark of white pine stumps. All three species, *affinis*, *approximatus* and *strobi*, are found in Connecticut, but it is *strobi* which is responsible for the injury to young white pine trees.

#### LIFE HISTORY.

There is only one generation each year. Just where the adult beetles hibernate or pass the winter is a question. Hopkins says\* "evidently in the ground." Though some closely allied weevils are found during the winter months under the bark of dead trees, stumps, etc., I do not recall ever having seen the white pine weevil in such places. As pupation takes place in the burrows in the leaders of the white pine, it would hardly seem necessary that the beetles go into the ground to pass the winter as adults. But wherever they hibernate they appear in Connecticut about May 1st on the young pines. They feed on the bark for a few days, and soon deposit their eggs in punctures (shown on plate XII, b.) in the bark of the leader or topmost shoot of the previous season's growth. The eggs hatch in from six to ten days, and the minute white grubs at first feed upon the cambium or inner bark, usually going downward and into the pitch. There is great variation in the length of the larval period depending upon food supply, latitude, altitude, etc., but as a rule the larva becomes fully grown in less than two months. It then excavates a larger and deeper burrow or cell in which, surrounded by shreds of wood like excelsior, it transforms. The cells are shown on plate XIII, and in Figure 17. The pupa stage lasts about ten days.

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\* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

There is a period of egg laying, so that with the variation in the length of the larval period, it is not uncommon to find the larvae in all stages of development and likewise pupae in the months of July and August. The adults begin to emerge through round holes in the bark as shown on plate XIII, a, the latter part of July and continue into September. Hopkins states\* that the principal period of emergence is between July 25 and August 15, and that practically all adults will have emerged by the middle of September. According to Hopkins it is believed that an individual adult weevil may live for two or three years depositing eggs each year. As has already been stated, in Connecticut the adults appear about May 1st, and they are fairly abundant on the pines for five or six weeks. They are also common in



Figure 17. Pupal cases, larval cells and exit holes of the white pine weevil. About twice natural size.

August during the period of emergence. Reared and collected specimens in the Station Collection bear the following dates: April 22; May 1, 7, 8, 13, 14, 15, 17, 22, 29, 31; June 3, 9, 10, 17, 23; July 10; August 3, 9; September 4.

#### DISTRIBUTION.

According to all accounts, the white pine weevil occurs from North Carolina northward into Canada and westward into Wisconsin, thus occupying the natural range of the white pine. It will probably be found in every town in Connecticut.

#### FOOD PLANTS.

As has already been stated, the chief injury is to white pine *Pinus strobus* but occasionally it attacks the Scotch pine *Pinus sylvestris*, the jack pine *Pinus divaricata*, the pitch pine *Pinus rigida*, the Norway spruce *Picea excelsa* and the red spruce *Picea rubens*.

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\* *Loco citato*.



## EFFECT OF INJURIES.

When the leader of a pine tree dies, the height growth is seriously checked, but whether or not this affects the diameter growth is uncertain as data are not available covering this point. Usually one of the lateral branches in the whorl immediately below the leader grows faster than the others and soon assumes an upright position, taking the place of the fallen leader. This causes a crooked trunk which the tree will outgrow in a few years if no further weevil injury occurs. But possibly and probably the new self-appointed leader may likewise be weeviled the following year, and the axis of the tree is exaggerated in its crookedness.

Occasionally two laterals instead of one will straighten and rival each other for the leadership. If both grow, a crotch or forked trunk is the result. If one is afterward weeviled and the other escapes, no great harm will result ultimately. Occasionally several laterals assume the upright position and make an illshaped tree. Forked and crooked trunks are undesirable in the growth of timber and the checking of the height growth is a serious matter in forest plantations where it is an advantage to obtain the maximum growth in the minimum time to bring the greatest possible return on the investment. If the plantation is a small one for ornament, for windbreak or to cover a watershed, the effects of serious weevil injury are no less important. Weeviled trees are always unsightly and never develop as satisfactorily as uninjured trees.

Kellicott observed\* that weeviled trees were more susceptible to the attacks of the pine tip moth *Pinipestis zimmermani* Grote.

Some plantations are very seriously injured by the white pine weevil, many trees losing a leader each season for a period of years, thus greatly interfering with the normal commercial development of the trees. Crooked, forked and otherwise deformed trees are not desirable for the production of timber and a stand of them would probably bring a lower price.

## DESCRIPTION.

The adult beetle is about one-fourth of an inch (4.5 to 6 mm.) in length, reddish-brown in color, marked more or less distinctly

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\* Canadian Entomologist, Vol. xi, page 115, 1879.

by a spot or patch of whitish scales on the apical third of each wing-cover near the median margin. The color varies from light to dark reddish-brown, and the markings also show great variation: in some specimens they are exceedingly distinct while in others they are almost wanting,—the wing-covers being nearly unicolorous. There are small and irregularly arranged patches of white scales on the thorax, the femora, and on the under side of the thorax and abdomen, but these are inconspicuous or wholly wanting in some individuals. Head and legs are colored

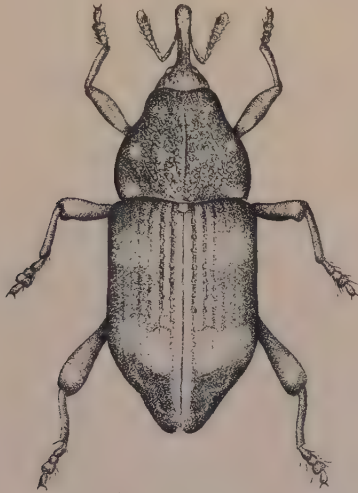


Figure 18. The white pine weevil. Enlarged about six times.

like the body, the head being elongated to form a slender snout after the fashion of the Curculionidae. The length of head and thorax together is only slightly less than that of the wing-covers. The thorax and head are both rather regularly and densely punctured, the punctures arranged chiefly in rows. The wing-covers are covered with horizontal striae with rows of pits in the grooves, the pits being considerably larger and deeper than the thoracic punctures.

The pupa is creamy white and about as long as the adult beetle. The eyes and the tips of the mandibles are brown, and as development progresses toward the end of the pupal stage, brownish color shows on the snout and legs. A pair of slender curved spines are borne at the tip of the abdomen.

The larva or grub is without feet, white and varying in size according to the age or period of development.

The egg has not been carefully studied in Connecticut, but according to Dr. Felt, is globular, whitish, transparent, about one-sixteenth of an inch in diameter and is deposited just beneath the bark. The adult weevil is shown in figure 18, and on plate XII, a, and larva and pupa on plate XIII, c.



Figure 19. *Habrobraconidea bicoloripes*, a common parasite of the white pine weevil. Eight times enlarged.

#### NATURAL ENEMIES.

A number of natural enemies of the white pine weevil have been recorded. Birds, particularly woodpeckers, tear open the bark covering the cells, and devour the larvae, pupae and also the adults. Hopkins states\* that "some of the larvae apparently die from disease, and when large numbers of them are crowded together the larger ones appear to feed on the smaller ones, so that on the average not more than from three to five per cent of the hatched larvae ever reach maturity and emerge from the infested terminals."

In Connecticut, an ichneumon parasite identified by Mr. H. L. Viereck as *Coeloides pissodis* Ashm. was reared from weevils

\* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

collected at Rainbow, town of Windsor, in 1911. A closely allied species *Habrobraconidea bicoloripes* Viereck, shown in Figure 19, has been reared in large numbers from weeviled pine leaders from Rainbow in 1910 and 1912, Yalesville 1912 and Portland 1914, and the parasites have been identified, some by Mr. Viereck and some by S. A. Rohwer. Parasitized material gathered by Mr. Zappe in Portland in 1914 yielded 50 adult weevils and five parasites, showing a parasitism of eleven per cent. The following parasites identified by Mr. Rohwer have also been reared from weeviled material in Connecticut:—*Microbracon nanus* Prov., Portland 1914: *Eurytoma pissodis* Girault, Rainbow, 1912: *Rhopalicus suspensus* Ratz., New Haven, 1914: also *Cyanopterus* sp. from Stafford 1911, which Mr. Rohwer thinks may not be a parasite of the white pine weevil. In West Virginia, Dr. Hopkins reared the ichneumon fly *Spathius brachyrus* Ashm., from the weevils.

#### METHODS OF CONTROL.

There are two possible means of reducing the amount of weevil injury as follows:—

- (1) To remove and destroy the infested leaders.
- (2) To prevent the leaders from becoming injured.

The former can be practiced in large white pine plantations where the latter on account of expense is not deemed practicable, but the latter is preferable in ornamental plantings where it is important to prevent injury and the cost does not matter.

Removing and destroying the leaders after they have been injured reduces the number of weevils and also the injury for the following year, but is it not better, where possible, to prevent the injury and thus save the leaders?

#### REMOVING INFESTED LEADERS.

The only method practiced in forest plantations is to cut out all the leaders as soon as they begin to wilt, making the cut with a pair of pruning shears at the base of the leader just above the whorl of lateral branches. The shoots are then gathered and burned before the weevils emerge. If the severed leaders are allowed to remain on the ground for two months or until the beetles escape, the practice would be of no value in reducing their numbers for the next year, though it might improve the appearance of the plantation.



As some of the weevils are parasitized, and the parasites as well as their hosts are destroyed by fire, Dr. Hopkins of the Bureau of Entomology has recommended that the cut shoots be placed in a tight box or barrel with an opening covered with fine wire netting which will allow the small parasites to escape, but through which the adult weevils cannot pass. This arrangement provides for the destruction of the weevils, for they will die in the cage, but allows their parasites to gain the open air so that they may attack and destroy more weevils. Such a cage should be so placed that it will not catch and hold water. It should be in partial shade as it might easily become overheated in full sun so that all insects inside would be killed.

For such a cage, Dr. Hopkins suggests and figures a barrel with wire netting on one or both ends, and a box has been tried in the experimental forest plantation at Rainbow, Conn. At first the wood was so affected by the weather that cracks opened up sufficiently large to allow the weevils to escape. It is very important that the receptacle be tight enough to hold the adult beetles. One of these cages is shown on plate XIV, b.

#### PROTECTING THE LEADERS FROM INJURY.

Simple experiments have been conducted by Mr. Walden and other entomologists of this Station for several years, with a view to discovering some application or other treatment to repel or destroy the adult weevils before they can lay their eggs, and thus save the leaders from injury. In order to be practicable the preparation must repel or poison the weevils without injuring the trees. Such a treatment would be welcome on many estates where pines are planted for ornament or shade and where weevil injury renders them very unsightly. Brief accounts of these tests may be found in the reports of this Station as follows: 1911, page 307; 1914, page 173; 1915, page 134.

#### SPRAYING.

It was found that commercial lime sulphur (1 part in 8 parts water) proved to be one of the best repellents tried. At first it was feared that this concentrated mixture, which is the same as is used on dormant trees to kill the San José Scale, would injure the leaves: but such was not the case. When applied at the proper time (about May 1st for most seasons in Connecticut)

only the old leaves are present. By old leaves is meant those of the preceding season's growth. Not the slightest injury could be detected, even where the mixture was applied directly to the foliage. The bark of the leader was coated with lime-sulphur applied with a small compressed air pump that can be carried about, as shown on plate XV, c.

Arsenate of lead, one ounce of the paste in one gallon of water, sprayed upon the leaders also gave some degree of protection, though not quite equal to the lime-sulphur. Both of these materials were tested in a small way in 1911, 1912 and again in 1915, and in nearly every case the weevil damage to the treated trees was less than half that of the untreated trees. In several cases not a single tree was weeviled where sprayed with lime-sulphur. In 1911 sixty per cent. of the check trees lost their leaders.

A number of other préparations were given a trial, and among these "whale-oil" or fish-oil soap, 8 ounces in one gallon of water, seemed to keep off most of the weevils without injury to the trees.

Mr. S. A. Graham of Minnesota has also experimented along this line and finds that creosote and carbolineum are more effective when applied to the leaders than lead arsenate and lime-sulphur, not a single tree being weeviled, though from thirty to forty per cent. of the untreated trees lost their leaders. However, some injury to the trees followed their use.

Mr. Graham also applied bands of tree tanglefoot to a number of pines, one band at the base and another just below the topmost whorl of branches. Very few of these trees were injured, which strongly indicates that the adults crawl up the trunks instead of flying into the tops of the trees. A large number of weevils were liberated in the vicinity of these trees and most of them were afterward found on the trunks below the lower tanglefoot bands.

#### JARRING.

In 1913, Dr. E. P. Felt, State Entomologist of New York, recommended\* collecting the weevils from the pine leaders, using a net of about 15 inches diameter. "This work should begin in April, as soon as the weather is moderately warm, and be con-

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\* Tribune Farmer, August 7, 1913; also 29th Report New York State Entomologist, page 32, 1913.

tinued for several weeks at intervals of approximately a week or ten days. Practical work done this season shows that it is possible to make four collections from an acre of young pine at a cost of \$1.28 an acre."

Dr. Felt states that at the outset two to four weevils were caught on each tree, but at the last collection only one or two were found in a row of perhaps 400 trees. Using Dr. Felt's experiments as a cue, similar tests were made in Connecticut in 1914 by Messrs. B. H. Walden and M. P. Zappe, about 1800 trees being treated and more than 1000 were under observation as checks.

For this purpose special nets were constructed having a rim about sixteen inches in diameter with a notch about three inches deep on the side to place against the trunk. After trying this net, it was found that more weevils could be captured by placing the net below the base of the leader and close to the trunk and rapping the opposite side of the leader with a stick as shown on plate XIV, a.

The tests were conducted in the State Forest reservations at Rainbow and Portland, on trees between five and eight feet in height, with results as follows:—

| <i>Rainbow.</i> |           |                  |           |
|-----------------|-----------|------------------|-----------|
|                 | No. trees | Leaders infested |           |
|                 |           | No.              | Per cent. |
| Net used        | 337       | 9                | 2.64      |
| Check           | 116       | 8                | 6.79      |

| <i>Portland.</i> |           |                  |           |
|------------------|-----------|------------------|-----------|
|                  | No. trees | Leaders infested |           |
|                  |           | No.              | Per cent. |
| Net used         | 1,462     | 141              | 8.9       |
| Check            | 1,009     | 191              | 18.9      |

The season was late and five collections were made at Rainbow, on May 8, 14, 21, 28 and June 3. At Portland four collections were made on May 15, 23, 29, and June 5. Possibly earlier collections would have given better results, though the treated trees in both cases had less than half as many injured leaders as the checks. Probably six collections could have been made at a cost of between \$1.50 and \$2.00 per acre.

Thus it will be seen that by spraying or by jarring the leaders, it is possible to greatly reduce the amount of weevil injury, and

the cost, though perhaps too great in forest plantations, would certainly be warranted in small ornamental plantations.

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## THE PINE BARK APHID.

*Chermes pinicorticis* Fitch.

There are several species of this genus which suck the sap from the various conifers. Some of these appear on the leaves, twigs or trunks, as bits of cotton or wool and are often called woolly aphids; others, like the spruce gall aphids, form swellings or galls at the base of the new growth, with the young developing inside the galls. In certain species the cotton-like tufts are present on the leaves and twigs and represent the females and eggs or migrants, and the galls on that or another host indicate another stage of the same insect.

It should be stated here that for many years several species of *Chermes* have been confused in entomological literature, and were disentangled by Dr. Edith M. Patch in her paper on "*Chermes of Maine Conifers*"\* in 1909. The present species

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\* Bulletin No. 173, Maine Agricultural Experiment Station, 1909.



*Chermes pinicorticis* was not particularly studied by Dr. Patch, and the available literature regarding the species is based on former studies and observations. Confusion may therefore still exist regarding *pinicorticis* but this cannot be determined until some one has made a careful study of its life history. But disregarding the identity and life history, the damage caused by the insect, its appearance on the trees and control measures are such, we believe, as to warrant the present paper.

The white tufts are common on the needles of young white pine trees, and the white flocculent patches may be seen on the bark of the trunk and branches of both old and young white pines. Not only does the insect occur on cultivated trees, but also on native ones throughout Connecticut. Though the injury from its attack is not well understood, it probably checks the growth and reduces the vitality of the tree, and when abundant may cause serious injury. A slight infestation need cause no alarm.

#### DISTRIBUTION.

Apparently this insect was first mentioned by Dr. Fitch as occurring in New York State in 1856. According to Storment\* it has been recorded from New York, Illinois, Iowa, Maryland and the District of Columbia. Dr. Felt states\*\* that Prof. Lawrence Bruner reported it from Nebraska in 1894. Dr. Patch states† that it occurs in Maine. It is also reported from Canada, Minnesota and Ohio and no doubt the species is very generally distributed, and may be expected to occur in nearly all the intervening territory wherever the white pine is grown. As has already been stated, it is found throughout Connecticut, material having been received from the following localities:—Avon, October 24, 1917: Danbury, June 6, 1914, May 22, 1917: Deep River, July 13, 14, 1915: Greenwich, July 10, 1910, October 4, 1911, June 13, 1913: Hazardville, January 5, 1918: Ivoryton, July 30, 1918: Middletown, June 11, 1907, May 28, 1913: New Canaan, June 22, 1917: New Hartford, July 1, 1909, July 18, 1919: New Haven, May 8, 1907, September 27, 1912: Rainbow, June 13, 1913: Riverside, June 22, 1915: Saugatuck, October 14,

\* Insects of Illinois, 20th Report, appendix, pages iii-xxiv, 1898.

\*\* Insects Affecting Park and Woodland Trees, page 193, 1905.

† Bulletin No. 173, Maine Agricultural Experiment Station, page 303, 1909.

1912: South Coventry, December 4, 1917: Southport, June 18,  
1912: Sharon, July 2, 1912: Wallingford, July 10, 1914: West-  
brook, November 3, 1916.

#### APPEARANCE AND INJURY.

The pine bark aphid appears as white tufts of cotton or wool at the base of the needles on the twigs, and as white flocculent patches on the bark of trunks and branches as shown on plates XV and XVI. According to Storment\* it occurs more abundantly and more generally on the north exposure of the trunk than on the other sides and around the base, and on the under sides of the lateral branches, indicating that it does not thrive in a strong light. Where there are only a few small scattered patches, they so closely resemble the hardened pitch or gum that without close examination, it is difficult to distinguish one from the other.

There is some question about the exact amount of damage done by the attacks of this insect, though it surely must be considerable in severe infestations. Storment\*\* states that a heavy infestation will kill the lower branches and occasionally the entire tree, and that generally the effect of the infestation is manifest in the shortened leaves and shorter new growth.

Swaine† states that "*Chermes pinicorticis* Fitch is a common and destructive species throughout Eastern Canada, and seriously injures many young white pines, particularly those growing in the shade." Dr. Patch‡ regards it as "a serious enemy to young white pines both in nursery stock and in the open." Finally the Bureau of Entomology§ is responsible for the following statement:—"The pine bark louse (*Chermes pinicorticis* Fitch) was found to be commonly associated with and evidently causes a considerable percentage of the white-pine twig blight which has been so prevalent in the New England States the past year."

Though this insect chiefly attacks the white pine, it is recorded by Dr. C. G. Hewitt|| as causing damage to Scotch pines in Canada.

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\* Insects of Illinois, 20th Report, appendix, page iv, 1898.

\*\* Ibid, page iv, 1898.

† 43d Annual Report Entomological Society of Ontario, page 88, 1913.

‡ Maine Agricultural Experiment Station, Bulletin 202, page 160, 1912.

§ Year Book U. S. Department of Agriculture, page 575, 1908.

|| Report of Dominion Entomologist, page 56, 1916.

## LIFE HISTORY.

Though the life history of this insect has not been worked out in detail, it is stated that the eggs begin to hatch on or before the first of May, the young emerging in great numbers from the woolly or cottony masses. At first they are very small and hardly discernible with the unaided eye, and they crawl over the bark for a time seeking a favorable place to attach themselves. They usually settle on the tender bark of the young twigs and begin to suck the sap, increasing in size rather rapidly. They soon change to a dark reddish-brown color approaching black, and the waxy secretion soon hides them in a white mass as though it were a tuft of cotton or wool. Winged females appear about the middle of May, but cannot be found two weeks later. Though the full seasonal life history has apparently not been worked out, indications point to several broods during the summer, and the winter is probably passed by wingless females on the bark, more or less covered by the masses of wax, or "wool" as it is called in some of the literature dealing with this insect. It is not known whether the pine bark aphid remains on the pine throughout the entire season or whether it has an alternate host like many other species of aphids.

## NATURAL ENEMIES.

Like other kinds of aphids, this species is preyed upon by various other insects which no doubt hold it in check under average conditions. The lady beetles are important and those recorded as feeding upon the pine bark aphid are the fifteen-spotted lady beetle *Anatis 15-punctata* Oliv., the two-spotted lady beetle *Adalia bipunctata* Linn., the twice-stabbed lady beetle *Chilocorus bivulnerus* Muls., and the spotted lady beetle *Megilla fuscilabris* Muls., commonly listed as *Megilla maculata* Degeer, a tropical species. The larvae of a syrphid fly, *Syrphus* sp., and of lace-wings or ant-lions, *Chrysopa* and *Hemerobia*, are listed by Mr. Stormont as devouring the pine bark aphids.

## CONTROL MEASURES.

As long ago as June 1898, small pines on the Station grounds were infested with a species of woolly aphid which, though not identified at that time, from subsequent observations I am reason-

ably certain was *Chermes pinicorticis*. A single application of "Fir Tree Oil" in the form of a spray rid the trees of these woolly insects.

The most extensive control measures of which I have any record were carried out in June 1911 in the plantation of the Middletown Water Company in the town of Middlefield, Conn. The aphids were abundant on some of the trees and seemed to check their growth. In response to inquiries, I advised spraying the worst infested trees with kerosene emulsion. The superintendent feared that the insect would gain the upper hand and that injury would befall all of the trees; therefore he sprayed the entire 38,000 trees. I visited the place during the operation: 7,000 had already been sprayed. These trees were planted in 1904, consequently were not too large to be sprayed easily. This treatment killed the aphids, the white patches soon disappeared, and there was no material injury to the trees; an occasional slight burning of the needles was observed.

Dr. Felt\* states that Dr. E. B. Southwick of the New York City Park Department has found that a driving spray was effective in combating this pest. In some cases, therefore, plain water from a hose if thrown from the nozzle with sufficient force, would prove the best remedy.

Mr. Storment† mentions the experiments in Illinois with kerosene emulsion which proved effective in killing not only the aphids but the eggs also.

In all probability a spray of nicotine solution and soap would also destroy these aphids, though for use in large plantations might prove more expensive than the kerosene emulsion.

Kerosene emulsion may be prepared as follows:—

|                           |           |
|---------------------------|-----------|
| Kerosene.....             | 2 gallons |
| Common Laundry Soap ..... | 1 pound   |
| Water .....               | 1 gallon  |

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a creamy mass is formed which thickens on cooling. Dilute nine times before using.

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\* Insects Affecting Park and Woodland Trees, Vol. I, page 195, 1905.

† Insects of Illinois, 20th Report, appendix, page xii, 1898.



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EXPERIMENTS TO CONTROL THE  
CHRYSANTHEMUM GALL MIDGE.*Diarthronomyia hypogaea* LOEW.

BY M. P. ZAPPE.

This insect was probably first introduced into Connecticut by florists of the State buying new varieties from other chrysanthemum growers. One grower in particular who grows large quantities of chrysanthemums for cut flowers and cuttings first noticed the work of this insect in 1916, and says that in two years it has caused \$5,000.00 damage. Other growers in the State suffered severe losses in 1917 and 1918. Seven towns in Connecticut are known to be infested with this insect, and the pest probably occurs in many others of which we have no record. The following towns are infested:—New Haven, Bridgeport, Hartford, Cromwell, Fairfield, Derby, East Haven.

Experiments were started in January 1919 to find some simple method of controlling this insect. Fumigation with hydrocyanic acid gas had been recommended, but this was quite a costly operation as it was only effective against the adult midges and had to be repeated every few days. There was also danger of burning the foliage by repeated fumigations, and danger to the operator and others who might come in contact with the gas which is deadly to human beings as well as insects.

The eggs of this insect are laid on the top of the plant where the new leaves are unfolding and as the leaves grow larger, the larvae make their way into the leaves. On large plants that are about to bloom the larvae get into the stem and enlarge and weaken it, causing the blossom to droop. Some varieties of chrysanthemums are very liable to attack by midges, while others are almost immune. In a house where several varieties are grown this is very evident. Some will be found badly infested, while others will not have a single gall. See plate XXXI.

The house in which the experiments were conducted was a small one, having a large center bench and a small one on each side. This house had been used for growing seedling pompons and at the time the experiment started the old plants had been cut off: New plants had sprung up from the roots and were about two inches tall. These plants were badly infested with midge galls.

The following treatments were applied:—

#### SECTION A. SCREENED.

##### Carbolic Acid Emulsion.

The section of the bench where this treatment was applied was screened with cheesecloth which after each spraying was carefully replaced in order to catch emerging adults from this plot and to prevent adults emerging elsewhere from attacking the plants. It was thought possible that the carbolic acid emulsion might penetrate the galls and kill the larvae within.

Crude carbolic acid..... $\frac{1}{4}$  pint.  
Yellow laundry soap..... $\frac{1}{4}$  pound  
Water.....1 quart

This was prepared in the following manner: the soap was dissolved in hot water, then the carbolic acid was added. This was all churned together until it became creamy. When ready to spray, this emulsion was diluted thirty times. The treatment was applied every three or four days for about two months, beginning January 3, and ending March 3, 1919. After six treatments a few adults began to emerge and later a few eggs were seen. At the end of the experiment after seventeen treatments, there were a few new galls present, but not nearly as many as under the screened check.

#### SECTION B. SCREENED CHECK.

This section of bench was screened on January 3, and on January 6 one male was found under the screen and another on January 13. On January 31 several adults of both sexes were seen and on March 3rd there were many new galls present on the small leaves.

#### SECTION C. SCREENED.

##### Nicotine Sulphate 40%.

This was used at the strength of one teaspoonful to one gallon of water plus one ounce of common yellow laundry soap. This treatment was applied every three or four days for two months. There were no adults seen under the screen, so it is safe to assume that they were killed either before they emerged, or while they were emerging. No young galls could be found at the end of the experiment.

## SECTION D. UNSCREENED.

## Check.

On February 3, one month after beginning of experiments, there were many eggs and larvae present on the young leaves. On March 3 there were many young galls present on plants in this section.

## SECTION E. UNSCREENED.

## Arsenate of Lead.

As the eggs of the chrysanthemum gall midge are laid on the surface of the leaves, it seemed to the writer that there might be a time when the young larvae were working their way into the leaves that arsenate of lead would kill them. This was applied the same as the other treatments using one ounce to one gallon of water. At first it looked as though this treatment would be of some value, as this section made a better growth and looked better than the rest. One month after starting the experiment there were many eggs and larvae present and at the conclusion of the experiment there were just as many new galls as on the check section.

## SECTION F. UNSCREENED.

## Fish Oil Emulsion.

This was made similar to the carbolic acid emulsion, except that one and one-half pints of fish oil were used instead of crude carbolic acid. This was diluted ten times. At the end of the first month injury was noticed; the edges of the leaves turned brown and dried up. The dilution was changed to one to fifteen, and at the end of the experiment there were a few new galls present on the young leaves.

## SECTION G. UNSCREENED.

## Powdered Tobacco.

It was thought that this might act as a repellent and prevent oviposition. It was applied by sifting on the top of the plants through a cheesecloth bag. This treatment proved of no value, as there were many new galls present at the end of the experiment.



## SECTION H. UNSCREENED.

## Scalecide.

This was used at a strength of one to twenty, and after a few treatments the edges of the leaves were burned, especially the older leaves. There were no new galls on the leaves that were left on the plant at the end of the experiment.

## SECTION I. UNSCREENED.

## Scalecide.

This treatment was used at a weaker strength than the above, being diluted one to thirty. After two months of treatment there was a slight injury to the leaves, but there were no new galls.

## SECTION J. UNSCREENED.

## Nicotine Sulphate 40%.

This experiment was started about a month later than the others and ended on the same date as the other experiments. At the beginning of the experiment there were many eggs and young larvae present on the new growth. These were all dead three days later. This treatment was applied every three or four days, and continued for a month. At the end of the experiment no new galls could be found.

Another experiment was conducted in a commercial greenhouse, using nicotine sulphate, 1 teaspoonful to one gallon of water and two-thirds of an ounce of soap. This was for the purpose of checking up our other results with the nicotine spray. Young chrysanthemum plants in this house had quite a number of old galls present and were sprayed at intervals of three or four days. The bench treated was mostly of one variety, except the ends, which had a few plants of other varieties. The bench was divided into three parts, both end sections were sprayed and the center section left for a check.

On February 5 the first treatment was given and at this time there were many eggs present, also large galls on the older leaves. The owner of the house began to take cuttings from the sprayed portions of the house on the 27th of February. All these cuttings were put into a propagating house with cuttings from untreated plants from other houses. On March 3 these

cuttings were examined and the sprayed ones were free from young midge galls, and on the untreated ones there were a number of young galls started. There were also a large number of galls present on the 'check' portion of the bench in the house where the spraying was done.

#### SUMMARY.

From the results of our investigations, it would appear that the best time to combat this insect is while it is still in the egg stage, or shortly afterward before the young larvae are entirely within the leaf.

Scalecide killed all eggs and young larvae, but injured the foliage. 40% Nicotine Sulphate and soap applied every three or four days will control this insect and most florists keep this on hand at all times so that this is probably the easiest and best spray for commercial florists to use.

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#### PREVALENCE OF GREEN CLOVER WORM ON BEANS.

##### *Plathypena scabra* Fabr.

An outbreak of the green clover worm occurred in 1919, and bean plants in nearly all parts of the state were suddenly riddled. At first, the caterpillars which were on the under side of the leaves, dropping to the ground on being disturbed, escaped notice. A careful examination, however, revealed them in large numbers and of all sizes. Both common beans and Lima beans were attacked, and more or less irregular holes eaten in the leaves. In some cases only the veins were left and the pods were also eaten.

Specimens were received from New Haven, Orange and Putnam, and correspondence and telephone calls regarding this insect occupied considerable attention of the office force the last week

in July and the first week in August. The Hartford County Farm Bureau reported twenty telephone calls in one day inquiring about the insect feeding upon beans.

In conversation with other entomologists, I learn that this outbreak was not local, but reached over a large portion of the northeastern United States.

The only prior record on hand of such an outbreak was in 1908, but it was not as severe as that of 1919. An account of the insect with illustrations was printed in the Report of this Station for 1908, page 828. Some of the same illustrations are used herein.

On account of the many complaints and inquiries, the following statement was given out to the press, on August 2, and was printed in many of the newspapers of the state:—

#### GREEN WORMS THREATEN BEAN CROP.

"Slender green striped worms are now devouring the leaves of beans in fields and gardens, and unless prompt measures are taken, the entire crop may be destroyed.

Lima and other shell beans should be sprayed with arsenate of lead, using one ounce of the paste or one-half ounce of the dry powder, in one gallon of water. It would be unsafe to apply this poison to string or snap beans which are nearly ready to harvest, but such beans may be treated by spraying the under surface of the leaves with common laundry soap, four ounces in one gallon of water, or nicotine solution, one teaspoonful in one gallon of water with an inch cube of soap dissolved and added. When disturbed, the worms wriggle and drop to the ground, where they can be reached by the contact spray which will kill all of them that it hits. It may be feasible to shake the vines, and spray the ground afterwards."

#### INJURY TO BEANS.

The injury is caused by the larvae which eat holes in the leaves. These holes are usually rather irregular in shape, and as the injury progresses, only the net work remains. The writer observed many gardens and fields of beans where the leaves were badly eaten. Pole beans, bush beans, shell beans, string beans and Lima beans were all attacked and severely injured.

Some injury was also done to soy beans. In a number of cases the larvae had eaten holes into the pods. At first the larvae do not eat entirely through the leaf, but the upper epidermis remains. In some cases the injury did not go beyond this point, and the leaves showed these holes as peculiar transparent spots.

#### FOOD PLANTS.

Clover is the common food plant of this insect, but occasionally, when abundant, it attacks and injures beans. Other plants attacked are peas, vetch, soy beans, tickweed (*Meibomia* sp.), strawberry and blackberry.

#### HABITS AND LIFE HISTORY.

This insect passes the winter in the adult stage and in the vicinity of Washington, D. C., the moths often fly during warm sunny days of winter. They emerge from winter quarters early. Chittenden records three generations annually in the latitude of the District of Columbia, though Coquillett found only two broods in Illinois. The eggs require from four to six days to hatch, and the caterpillars reach maturity in about twenty-five days. From ten to fourteen days are passed in the pupa stage.

In 1908, the first adult that was reared from larvae, emerged on July 24. Another emerged on July 29 from a cocoon formed July 16. The moths do not appear with any particular regularity, but are found throughout the latter part of the summer. Specimens in the Station collection bear dates ranging from June to November.

The larvae usually feed from the under side of the leaves and wriggle violently when disturbed. The small ones drop on silken threads, but those nearly grown drop to the ground, wriggling and throwing themselves about. Different sized larvae are found feeding side by side. The larva is slender, about the same color as the leaf upon which it feeds, and it loops with the front half of the body somewhat after the manner of a Geometrid larva. Many of the partially grown larvae were yellow and had a sickly appearance. Probably such would never transform.

#### DESCRIPTION.

Egg:—About 0.5 mm. in diameter and 0.35 mm. in height. Globular, somewhat flattened with the upper half deeply grooved. Light in color.



**Larva:**—About 25 mm. (one inch) in length, about 3 mm. thick in thickest portion near middle from which it tapers slightly toward the head, and considerably toward the posterior extremity. Color light green, striped longitudinally with darker green and fine white or cream-colored lines. Head pale green, shining and hairy. True legs, pale green. There are three pairs of abdominal prolegs in addition to the anal prolegs. Each segment bears dorsally, ventrally and laterally, a number of dark hairs.

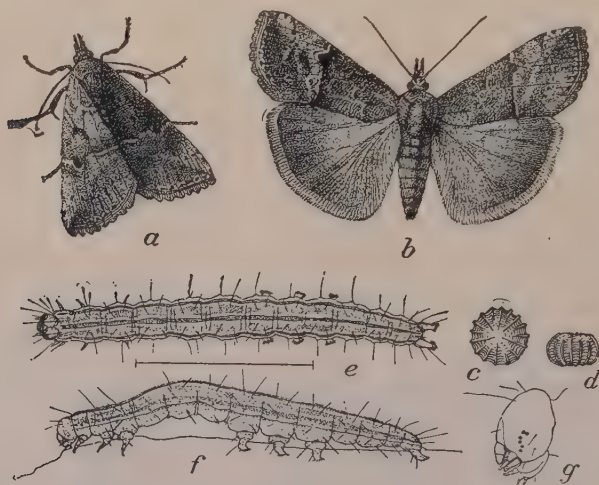


Figure 20. The green clover worm: *a*, moth in natural position with wings folded; *b*, same with wings expanded; *c*, egg from above; *d*, side view of egg; *e*, penultimate stage of larva, dorsal view; *f*, same from side; *g*, head of larva. All enlarged. (After Chittenden, Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture.)

**Pupa:**—About 12 mm. in length, 3 mm. thick, dark brown in color. A dorsal ridge extends from the head over the thorax and first four segments of the abdomen. Some pupae occur in rolled leaves and are usually enclosed in a white silken web or cocoon of loose texture; others are in the ground in earthen cells formed by webbing together particles of soil.

**Adult:**—Wing-expanse from 25 to 37 mm. (one to one and one-half inches) blackish or purplish brown in color, with the outer part of the fore wing shaded with light gray, often showing a brownish tinge. The rear wings are broad and well rounded,

smoky brown and without markings. The males usually show less prominent markings than the females, but there is great variation. Body, legs and antennae brown. The palpi are prominently elongated and project in front of the head as is the case with other members of the group of snout-moths. They are also called Deltoid moths on account of the distinctly triangular shape which they assume when at rest with wings folded. The males are usually larger and more nearly of a uniform color than the females.

The appearance of all stages of this insect is shown in figure 20 and on plate XIX of this report.

#### CONTROL MEASURES.

In order to make a few tests on controlling this insect, some small plots in Hamden, as shown on plate XVIII, were sprayed by hand on July 31, as follows:—

Arsenate of lead (paste) one ounce in one gallon of water, applied to nine rows.

Black Leaf 40, one teaspoonful, one ounce laundry soap, in one gallon of water, applied to two rows.

A few days later, practically all larvae were dead where the arsenate was applied, and only a few were living on the rows treated with nicotine solution.

In order to ascertain if the contact treatment was immediately effective, the vines were brushed over a piece of paper spread upon the ground, and the spray nozzle passed quickly over the paper on which the larvae had dropped. The three following sprays were tried in this manner:—

Black Leaf 40, one ounce soap, one gallon water.

Black Leaf 40, one-half ounce soap, one gallon water.

One ounce soap, one gallon water.

In each case, all of the younger larvae dropped in their tracks, wriggled slightly and died. The larger ones crawled a short distance, but soon died. In no case were they able to get off the paper after being hit by the spray.

In the writer's own garden, clear water from the hose was thrown with considerable force in the form of a spray against the under sides of the leaves. Most of the larvae were dislodged and I am sure that many of the smaller ones were unable to return to the plants.

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PRESENT STATUS OF THE EUROPEAN CORN BORER  
IN THE UNITED STATES.

In the Report of this Station for 1918, page 316, is given an account of the "European Corn Borer *Pyrausta nubilalis* Hubn.," and its distribution as known at that time. Since this article was written the insect has been discovered in New York State at two widely separated points, namely, near Schenectady and in the western part near Lake Erie. This westernmost infestation also extends into the State of Pennsylvania. Its limits have not yet been definitely determined. An increased area has been found which extends northward into New Hampshire.

## MASSACHUSETTS INFESTATION.

Recent examination of the infested area in Massachusetts shows that the pest has spread farther than was known to be the case a year ago. Instead of covering 300 square miles as was estimated last year, probably six times that number is more nearly the size of the present infested area. The original infestation has extended northward into New Hampshire, and has spread southward from Boston along the bay and practically the whole of Cape Cod is infested. The westernmost towns in which the pest has been found are Tyngsboro, Sudbury and Framingham. There are 111 towns, containing nearly 2,000 square miles, in the infested area.

## NEW HAMPSHIRE INFESTATION.

The insect was not discovered in New Hampshire until late in the summer and at the time of this writing (November 22, 1919), information just received from the New Hampshire

authorities, states that in that state only the three towns of Seabrook, Plaistow and Kingston have been found infested by the European corn borer. Seabrook is a coast town and joins Massachusetts, but is separated from Plaistow and Kingston by two towns. Plaistow also joins Massachusetts, and Kingston joins Plaistow on the north. Apparently there is no general infestation in New Hampshire.

#### NEW YORK INFESTATION.

The pest was found in New York State in January, 1919, near Schenectady, where at present twenty-two towns involving the five counties of Albany, Schenectady, Montgomery, Fulton and Saratoga and an area of about 800 square miles, are infested.

Late in the fall a sparse infestation was discovered in the extreme western portion of the State, along the shore of Lake Erie, extending from Angola, Erie County to Fredonia, Chautauqua County, and southward some ten miles, nearly to Gowanda, an approximate area of perhaps 500 square miles. In all of the New York territory, the infestation is less intense, and the injury much less noticeable than in the older infestation in Massachusetts near Boston.

#### PENNSYLVANIA INFESTATION.

A slight and scattered infestation has been found in the town of Girard in Erie County, Pa., about two miles south of Lake Erie. Only a few larvae were found in one corn field, and these have been doubtfully identified as those of the European corn borer.

#### CONNECTICUT CORN BORER A DIFFERENT SPECIES.

It was mentioned in a foot note on page 316 of the last Report of this Station that borers had been found in corn stalks in Milford, Conn., which might prove to be the European species. At first the larvae seemed scarcely different from preserved material of *P. nubilalis* which the writer collected in eastern Massachusetts in September 1918. Subsequent study of larval characters, however, showed slight differences, and specimens were sent to Dr. E. P. Felt, Albany, N. Y., and to the Bureau of Entomology, Washington, D. C., where they were examined by Mr. Heinrich. Both these entomologists regarded the Con-



necticut material as belonging to the genus *Pyrausta* and probably a native species, but advised that the adults be reared so that the identification would not rest on larval characters alone. It was with considerable interest that we watched the material in the breeding cages, and when no pupae were formed the latter part of May, when adults of *P. nubilalis* should be emerging, it was another indication that our species was something else than the European Corn Borer. The first pupa was noticed on June 26, and the first adult emerged on July 7. During the next few days several other moths appeared. These resembled very closely the specimens of *Pyrausta penitalis* Grote in the Station collection. Specimens were sent to Washington and were identified as a new species since described as *Pyrausta ainsliei* by Mr. Heinrich. This species is discussed more in detail on page 173 of this Report.

#### FUNDS FOR COMBATING THE EUROPEAN CORN BORER.

Soon after the discovery of the borers in corn at Milford, I gave a talk before the Farmers Association of the General Assembly on March 25. It was the sense of the meeting that the State should make some provision for fighting the insect in case the Milford larvae should prove to be the destructive European species. Also in case future infestations should be found it seemed wise to have some appropriation available for controlling the pest and not be obliged to wait until the convening of the next General Assembly. Consequently a bill was drawn up and passed making provisions as follows:—

#### Chapter 186, Public Acts of 1919.

#### An Act making provision for the Suppression of the European Corn Borer.

*Be it enacted by the Senate and House of Representatives in  
General Assembly convened:*

Section 1. The board of control, on recommendation of the director and entomologist of the Connecticut agricultural experiment station, at its discretion, is authorized to expend a sum not to exceed ten thousand dollars for the period ending September 30, 1921, for the suppression of the European corn borer. All expenditures authorized by the provisions of this act shall be paid from any unexpended balance in the treasury upon presentation of vouchers approved by the director of the Connecticut agricultural experiment station.

Section 2. This act shall take effect from its passage.

Approved, May 2, 1919.

So far not a dollar of this money has been expended. Nearly \$200.00 was expended around Milford in the Spring, but this and the cost of the scouting throughout the State has been paid out of the general appropriation made to the Station for work with insects.

## A NATIVE BORER ATTACKING CORN.

### *Pyrausta ainsliei* Heinrich.

Many cornfields were examined during the winter months to see if any trace of the European corn borer could be found in Connecticut. On March 12, Messrs. Zappe, Chamberlain and Coddling visited Milford, as this town is a seed-growing center and much seed corn is shipped out from there to all parts of the country. It seemed probable that certain varieties of corn on the ear might have been brought into this region, in order to grow it for seed, and that some of it might have come from an infested section. After examining several fields in Milford the men visited some small plantations on North Street about three-fourths of a mile from the center. Mr. Chamberlain was the first to discover larvae in the cornstalks. Mr. Zappe telephoned to the office that they had found the European corn borer, and I visited the place in the afternoon.

The larvae resembled very closely those in preservative which I had gathered in eastern Massachusetts the preceeding Autumn. In fact we were not able to separate them definitely. Mr. Coddling sent specimens to Dr. F. H. Chittenden of the Bureau of Entomology at Washington, who submitted them to Mr. Carl Heinrich, a specialist.

I attended a conference at the State House, Boston, on March 14, and saw Mr. D. J. Caffrey who was in charge of the European corn borer investigations of the Bureau of Entomology, and informed him of the discovery at Milford. At my request, Mr. Caffrey and Mr. W. R. Walton also of the Bureau, visited the region on March 22. We examined some of the infested fields around Milford and they noticed some discrepancies between the injury and that caused by the European corn borer.

Under date of March 15, Mr. Walton wrote that "the specimens were submitted to Mr. Heinrich, yesterday, who examined them carefully and is quite satisfied that they are the larvae of a

species of *Pyrausta*, but he was not willing to make any statement with regard to the species, although he was inclined to believe that it was not identical with *nubilalis*."

Mr. Walton also added:—"However, as our specialists admit that they are not able to distinguish the various species of *Pyrausta* in the larval stages, it seems advisable to proceed on the basis of the supposition that the insect which has been discovered in your State is the European corn borer, as this seems to be the only safe course. I think we all realize by this time that the only way to settle this matter definitely is to rear the adults, and of course that will not be possible for some weeks yet."

As this insect was believed to be the real European corn borer, the following information was given to the press under date of March 15:—"What appears to be a small infestation of the European corn borer was found this week just north of the village of Milford by entomologists of the Agricultural Experiment Station in New Haven. Measures have been taken to suppress the pest."

This notice was printed by many newspapers of the State on March 15 and later. A similar announcement was printed in the Journal of Economic Entomology for April, Vol. 12, page 218.

In April, specimens of the larvae were sent to Dr. E. P. Felt, State Entomologist of New York, who had been making a study of the larvae infesting corn in that State and comparing them with the larvae of other species of *Pyrausta*. Under date of April 8 he wrote as follows:—

"They resemble very closely Massachusetts and New York specimens and for the present we must assume their identity until this is disproved, if it ever is, by rearing."

In looking over Dyar's List of Lepidoptera, I find that there are twenty-five species of *Pyrausta* occurring in the eastern United States, sixteen of which are in the Station collection. As many of these species are unknown in their immature stages, it is not surprising if our specialists are not able to identify the larvae with certainty.

Evidently there was only one way to settle the identity of the Milford corn borer—rear the adults. Here again the Milford larvae did not act quite like the European species; instead of transforming in May as well-behaved European corn borers should, they kept on eating in the old stalks, and the very first

sign of a pupa did not appear until June 26,—more than a month after the time when adults of *nubilalis* should have emerged. It was a period of anxious though watchful waiting.

But meantime forces had not been idle. Preparedness was the watchword. Soon after the borers were found, men were employed to cut, rake together and burn the infested stalks. For, after all, the identity of the borer was uncertain and it might prove to be the dreaded European species. Connecticut could afford to take no chances.

Mr. George D. Stone, a trained gipsy moth scout who had fought with the American Expeditionary Forces in France, and who had been employed by Mr. Davis on gipsy moth work in the eastern part of the State, was brought here to scout for corn borers and to take charge of burning the infested stalks.

A careful scouting was therefore carried on, followed by burning infested stalks, in most cases with the full co-operation of the owner. In some cases the owners cut and burned the stalks themselves under Mr. Stone's direction or supervision. In most of the seed-growing farms in the Milford region, the soil is rather light and the season early. Some of the stalks had already been plowed under before the fields were examined. The stalks were burned in twelve fields having a combined area of about nineteen acres. The owners burned about one and one-half acres without assistance. Mr. Stone burned about four acres without help from the owners, and the remaining thirteen and one-half acres were burned by Mr. Stone and the owners co-operating.

Mr. Stone began this work on March 27 and finished on May 10, covering ground rapidly on a motorcycle. The total cost of this work including wages and expenses was \$192.02. Though more attention was given to the Milford area than any other, Mr. Stone visited Wethersfield, Rocky Hill, Cromwell, Middletown, Stratford, Orange, New Haven, Woodbridge and Hamden. In some of these places the larvae were found in cornstalks, and in nearly all of these towns, the stalks of smartweed (*Polygonum*) in the cornfields contained larvae. Messrs. Zappe, Chamberlain and Walden did considerable scouting before and after the discovery of the larvae in the stalks at Milford, visiting in all eighty-five cornfields in various sections of the State; they noticed the tendency of the smartweed stalks to infestation, and finally



on visiting a cornfield, sought at once the low places or depressions where this weed commonly grows. In many cases they found the larvae in the smartweed stalks, and if the insect was abundant in that locality, some larvae were usually found in the corn.

Imagine our interest when the first moth appeared in the breeding cages on July 7, followed by profound relief, for surely it was not the European corn borer *Pyrausta nubilalis*. It was identified provisionally as a native species, *Pyrausta penitalis* Grote, and this identification was later confirmed by Mr. Heinrich at Washington. The larvae resemble very closely the European corn borer, and only an entomologist and a specialist on *Pyrausta* larvae at that, can distinguish them. But their tunnels average somewhat shorter, and there are not so many in a stalk, and so far as my observations go the tassel and ear are not attacked, or if so, not to such a degree as is the case with that destructive pest, the European corn borer.

#### INJURY TO CORN STALKS.

As has already been mentioned, no injury to tassels or ears by this insect was noticed in Connecticut. The holes were in the main stalks, usually two or three feet from the ground, and just above a node, though in some cases they were just above the first node, only a few inches from the ground. As a rule, the burrows were not more than two inches long, slanted upward from the entrance and were wider near the upper end. Evidently the larva excavated its burrow to a sufficient size so that it could turn around, for all or nearly all of the larvae were found headed downward. Sometimes there were several holes in a stalk, but usually only one. The most found in any one stalk was nine. Consequently the plants were not much injured, and their vitality and growth were unimpaired. Just why the larvae go into the corn at all is a question. If for food, one would expect them to eat larger tunnels. Possibly it is as a place to pass the winter. Yet many of them hibernate in the *Polygonum* stems, and seem to be none the worse for their rather precarious winter quarters. The appearance of the infested stalks is shown on plate XXII. In many cases the stalks had been pecked into by birds, and the burrows were empty.

## IDENTITY.

Though this species was provisionally identified as *Pyrausta penitalis* Grote and in the adult stage resembles that species in collections, recent detailed studies by Mr. Heinrich led him to conclude that heretofore two species have been confused under this name, and that the chief corn-boring species was new and undescribed. As its life history has been carefully studied by Mr. George G. Ainslie, of the Bureau of Entomology, who is stationed at Knoxville, Tenn., Mr. Heinrich has named it *ainsliei*.\* At the time that this paper goes to press Mr. Heinrich's description and name of the new species has just been published.

## DISTRIBUTION IN THE UNITED STATES.

Apparently this species occurs throughout the eastern United States as it has been found in Massachusetts, Connecticut, New York, New Jersey, Tennessee, Illinois, Missouri and Kansas.

## DISTRIBUTION IN CONNECTICUT.

Undoubtedly this corn borer occurs throughout the state, but we have records of it in weeds or in corn from the following towns:—Wethersfield, Cromwell, Middletown, Durham, Meriden, Milford, Orange, Woodbridge, Hamden, New Canaan and Ellington.

## FOOD PLANTS.

The larvae occur most abundantly in the stems of the larger plants of smartweed or jointweed of the genus *Polygonum*, and particularly in that species sometimes called "Lady's thumb" or "heartsease," *Polygonum Persicaria* Linn. This is the species with a dark blotch on the leaf. I am by no means satisfied that the insect is confined to that species and probably it may occur in any of the larger-growing species of *Polygonum*.

Heinrich states† that "the natural food plants of *P. ainsliei* are *Polygonum*, ragweed, and similar plants: and it is frequently

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\* Note on the European Corn Borer (*Pyrausta nubilalis* Hübner) and its Nearest American Allies, with Description of Larvae, Pupae, and One New Species, Journal Agricultural Research, Vol. XVIII, page 171, Nov. 1, 1919.

† Ibid., Vol. XVIII, page 176, 1919.

found in corn associated with *P. nubilalis*, for which its larva is easily mistaken." In several cases, what is believed to be the same borer was found in the stems of "lamb's quarters," "goose-foot" or "pigweed," *Chenopodium album* Linn. Similar larvae were found in stems of "beggar's ticks," *Bidens frondosa*, but as the adults were not reared, it is impossible to be sure of its identity.

#### LIFE HISTORY AND HABITS.

The adults emerge in Connecticut the first half of July and soon mate and lay eggs. Our specimens in a large cage over corn plants at the Station Farm at Mount Carmel apparently did not lay any eggs, though there were several individuals present of each sex. Several searches were made, but no eggs could be found. Yet on August 9, small larvae were found boring in smartweed in Hamden, and Mr. Stone found them in Ellington August 11.

Some of the infested smartweed stems were placed in the cage on August 16, and some good-sized uninfested plants of smartweed were transplanted into the cage. Larvae soon left the cut stems and bored into the stems of the growing plants. In September, I noticed that the stems of the smartweed plants were well riddled and several of the larvae were at work in the corn stalks.

Apparently there is only one brood or generation each year in Connecticut, the winter being passed in the stems of plants, particularly in corn and *Polygonum*. The larvae do some feeding in the early summer, pupate late in June, and the adults emerge early in July. The eggs must hatch in July and the larvae spend the remainder of the season tunneling in the stems of plants, often leaving one stem to go to another.

The following paragraph is copied from Mr. Stone's notes:—

"Several instances were observed where the larva had left corn and entered smartweed and *vice versa*. The tunnels were noticeably much shorter where this had taken place, and if anything the borers showed a more mature development. In fields where borers were plentiful, careful observations were made and not a single instance was discovered where a larva had entered a stalk just beneath the leaves. However, many cases were seen where the borer had passed through the sheath of the leaf without entering the stalk at that point. In many cases a semi-circle was

cut in the edge of a leaf directly over the point of entrance into the stalk. The borers entered the stalks on nearly all parts from roots to tassel: the burrows usually were made between the nodes, though in a few cases they occurred directly at the nodes. In smartweed, the entrance was invariably just above the node, and in the majority of cases from two to four inches above the ground, although in a few cases, larvae were found boring in the roots."

#### DESCRIPTION.

**Egg.** The writer has not seen the egg-mass of this species, as none were laid by the females reared. Some eggs dissected from the body of a female were white and slightly longer than broad.

**Larva.** Length about 14 mm., thickness about 2.5 mm., color dirty white or gray to light brown, rather distinctly and conspicuously spotted with darker brown tubercles: dorsally, these tubercles form four longitudinal rows, and there is another row below the spiracles on each side: the tubercles are on the front of each segment forming a transverse row. Beginning with the abdominal segments there are two smaller tubercles on the rear half of each segment. There are also a number of other smaller tubercles definitely arranged. Each tubercle bears a hair. Head dark brown, legs light, unicolorous with ventrum.

**Pupa.** Length about 12 mm., thickness about 2.5 mm., color reddish brown, somewhat darker on dorsal than on ventral surface, head projecting distinctly beyond base of antennae and ending in a blunt projection. Dr. Edna Mosher has studied this pupa in comparison with that of *nubilalis* and the results have been published.\*

**Adult.** Female wing-expanse about 28 mm., color buff, marked with two submarginal narrow zigzag transverse lines. There is usually a darker shading in the discal area. Head, thorax, abdomen, legs and antennae all about the same color as the wings. Male, usually a little smaller than the female, often darker with similar though usually more prominent markings.

There is great variation in the size, color and markings of both sexes of this species.

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\* Journal of Economic Entomology, Vol. 12, page 387, October, 1919.



## CONTROL METHODS.

The injury to corn by this insect, so far as observed in Connecticut, has not been of such extent or character as to indicate that control measures are necessary. Probably it is only during occasional seasons when the insect is unusually abundant that it attacks corn: the remaining seasons it is probably present in normal numbers in smartweed and nobody pays attention to it. However, if it should again become unusually prevalent and attack corn, the stalks should be cut into short pieces—say one-half inch in length, and put into a silo or fed directly to stock, the same as ought to be done in case of corn infested by the European corn borer. Stalks that are left in the field over winter should be burned before May 1st. The fields should be kept free from a large growth of smartweed, thus greatly reducing the probability of the corn becoming infested.

## THE STALK BORER.

*Papaipema nitela* Guenée.

The common native stalk borer *Papaipema nitela* Guen., and its variety *nebris* Guen., is present every year in Connecticut and infests a large number of plants including corn, bean, potato, eggplant, tomato, rhubarb, spinach, dahlia, aster, chrysanthemum, gladiolus, lily, hollyhock, peony, sunflower, and most of the common vegetables and larger weeds. In fact, it will tunnel in almost any herbaceous stem. Last year I found a larva in the stem of muskmelon near its base. In 1919, of the specimens submitted to the office, one larva from Greenwich was tunneling in the new shoot of a peach tree, this shoot growing near the ground. Another lot of specimens from Putnam included one larva boring in a raspberry cane.

The stalk borer was abundant in 1918, and caused considerable damage throughout the state, but was even more abundant the past season, and did more injury. Also it seemed to attack corn more than other crops, though perhaps the extra attention paid to the corn crop and the inspections made on account of the possibility of finding the destructive European corn borer may be responsible for bringing this injury to light. Thus between June 12 and August 18, which represents the period of the

greatest activity of the larvae as borers, specimens were sent in from the following places:—

Litchfield County—Litchfield and New Hartford.

Hartford County—Hartford, East Hartford, East Windsor, Windsor, Bloomfield, Granby, Canton Center, New Britain and Southington.

Tolland County—Ellington.

Windham County—Putnam, Pomfret and Sterling.

Fairfield County—Greenwich and Stamford.

New Haven County—New Haven, Hamden (Highwood, Whitneyville and Mt. Carmel), Cheshire, Meriden and Clintonville.

Middlesex County—Saybrook Point.

New London County—Lisbon.

In addition to these localities, Mr. George D. Stone, who was employed to examine cornfields throughout the state, sent in material or observed this insect or its ravages in Litchfield, Hartford, Tolland, Windham, New Haven and New London Counties. These records show that the insect not only occurs, but has injured corn the past year in all sections of the state. Probably it was the most noticeable insect pest of the crop during 1919, and also did more damage than any other species.

The injury is of two sorts. When the young larvae attack the corn, they usually feed on the leaves at first near the whorl, eating ragged holes in them, or eating into the leaves before they unroll. This last mentioned form of injury often shows, when the leaf gets larger, as a row of holes across the blade, somewhat after the manner of "bill-bug" injury. Mr. Stone writes: "The *Papaipema* larvae were found nearly everywhere in Windham County, but not abundant. Their work seems to be very distinctive when the corn is young, and later when the leaves grow out, rows of from three to five little holes across the leaf can be observed. Investigation will invariably show that the borer is inside the developing tassel, or if the holes are far out upon the leaf it will be found boring in the stalk."

The larva later does tunnel downward in the stalk, often going quite to its base. In many cases the characteristic leaf injury was present, but on searching for the cause the larva could not be found, and the injury apparently stopped. Probably many larvae are destroyed by birds or predaceous insects before they enter the stalks. Like the army worm this larva is often found in the top of the corn plant in the whorl at the base of the

leaves, and not very well protected. The characteristic leaf injury is shown on plate XXIV.

The larva of the stalk borer is about one and one-half inches long when mature. In its earlier stages it is somewhat smaller, and is distinctly striped lengthwise with brown and white. There is a rather broad lateral white stripe on either side which is interrupted on the first four abdominal segments, thus giving the appearance of a broad transverse band or girdle of dark brown or gray. The larva is shown on plate XXIV, c. In its mature stage just before pupating, the conspicuous stripes gradually disappear, and the larva is a dirty greenish gray color.

The adult is a purplish gray moth with a wing-spread of about one and one-fourth inches. The typical form *nitela* is nearly uniform in color with a transverse submarginal lighter band shading into the darker margin on the forewings. On some specimens rather inconspicuous black spots show in the discal area. The variety *nebris* Guen., resembles the above, except that it has conspicuous white spots in the discal area, and is shown on plate XXIV, b. From the material gathered from corn and other plants in Connecticut, both forms have been reared, but variety *nebris* is much the more abundant.

There is only one generation each year, and the insect probably passes the winter in the egg stage on the stalks of pigweed, ragweed and other common weeds. These eggs hatch early in June, and the young larvae at once feed upon any suitable plant that is available. The stalk borer occurs throughout the United States and Canada east of the Rocky Mountains.

The stalk borer was strongly parasitized by dipterous larvae in 1919. Mr. Stone saw many dead larvae in Tolland County, and by August 15, could find no living ones in Hartford County. Probably by that time they had pupated. Much of the larval material which he gathered in various parts of the state never transformed, but gave up dipterous larvae, the parasites often pupating in the box in transit.

The parasites reared, were identified by Dr. J. M. Aldrich of the Bureau of Entomology at Washington, as *Masicera myoidea* Desv., and emerged from material collected in Windsor, Hartford, New Britain, and New London.

On account of the large proportion of the larvae being parasitized, a small proportion of adults were obtained from the material

gathered in the field, and this condition leads us to believe that the stalk borer may not be prominent next year in Connecticut cornfields.

#### CONTROL MEASURES.

When the larvae are feeding upon the leaves at the tops of the corn plants, dry arsenate of lead sifted into the whorl will doubtless kill them. After the larvae have commenced to tunnel inside the stalks, there is no satisfactory or practicable method of control that can be practiced in large fields, other than destroying the infested stalks when found.

With a few choice plants in the garden, it may be possible to cut into the stem lengthwise and destroy the borer. Such methods, however, cannot be practiced under field conditions. The destroying of all the larger weeds in which the caterpillars can live will be an aid in reducing their numbers. Burning the stalks of weeds around the field in late fall or early spring to destroy the eggs is to be recommended where the stalk borer is a serious menace to field crops.

#### INJURY TO CORN IN CONNECTICUT BY CRAMBUS PRAEFECTELLUS ZINCK.

On July 3, Mr. L. F. Harvey, County Agricultural Agent, brought to the laboratory some corn plants from a field on Townsend Avenue, New Haven, which had been injured in a peculiar manner by a larva boring into the side of the stalk near its base. This field was only three or four miles from the center of New Haven and contained about an acre. It was in grass in 1918, and plowed in the spring of 1919 and planted to corn.

The plants began to look sickly when only a few inches high and the outer leaves turned brown and died: later the entire plant followed suit. An occasional plant escaped attack and was much larger and more vigorous than the other plants in the field. A few hills near one end of the field were not attacked, and these and occasional scattered stalks produced ears. The crop was almost a total loss.

At first we failed to notice the larva at the base of the stalks because it dropped away with the soil from the roots when the



plant was pulled up, and even after noticing its presence, it was difficult to obtain one as it would wriggle away into a crevice in the soil.

Mr. Zappe with Mr. Harvey examined the plants and collected more material. Later, on July 10, the writer visited the field, which had the appearance shown on plate XXV, a.

Each stalk attacked had a hole eaten into one side at or just above the surface of the ground, as shown on plate XXV, d. Apparently there was only one larva in a stalk. The larva causing the injury was nearly always enclosed in a case formed by webbing together particles of soil as is shown on plate XXV, c. At the time this insect was supposed to be the corn web-worm *Crambus caliginosellus* Clem., a common species which causes considerable injury to corn in the middle and southern Atlantic States.

From the material gathered and placed in the insectary, four adults were reared about the first of September, and proved to be *Crambus praefectellus* Zinck., a native species, which has not heretofore been recorded as causing injury to corn.

The larva is about 12 mm. long, 2.5 mm. thick, dirty white to ash-gray in color, rather prominently marked with darker tubercles. Each abdominal segment bears eight: six in a transverse line near the front margin of the segment, the outer ones being below the spiracles: two transversely elongated ones just back of the middle two, but more widely separated. Prothoracic shield whitish and shiny marked with several small dark gray spots. Anal shield peppered with dark gray spots. Head whitish, shiny, mottled dorsally with brown. Legs, prolegs and ventral surface whitish. Each tubercle bears one or more hairs. Appearance of the larva is shown on plate XXV, b.

The adult is a Pyralid moth, having a wing-expanse of from 20-24 mm.: fore wings brown with a longitudinal white band narrowing to a point before reaching the margin. There is also a brown dash nearly bisecting the apical angle of the fore wing, formed by white markings on each side, but this dash is usually darker than the ground work of the wing. There is a narrow, wavy submarginal transverse line of darker brown; between this line and the margin is a row of five black elongated dots or short dashes. The terminal fringe is light brown. Rear wings white, with a brownish tinge in some individuals. Legs and antennae light brown. Adult is shown on plate XXV, b.

Mr. George G. Ainslie of the Bureau of Entomology, Cereal and Forage Crop Insect Investigations, stationed at Knoxville, Tenn., who has studied this and allied Pyralids, informs me that he has records of *præfectellus* being taken on corn from Florida, Arkansas and Tennessee, and on wheat from Indiana, but in no case was the injury of any extent or of any real importance.

Professor C. H. Fernald in "The Crambidae of North America," published in 1896, states that the early stages and food plants are unknown.

There are few references in literature to this species, and most of them are systematic rather than economic. Apparently this is one of the first instances, if not the first, of any serious injury being caused by this insect.

### THE ARMY WORM.

*Cirphis (Heliophila) unipuncta* Haw.

In certain seasons the army worm is present and attacks corn. During the outbreaks, like that of 1896 and 1914 in Connecticut, the larvae may injure any grain, grass or corn crop, but in many other seasons when there is no particular outbreak, a few larvae here and there are found feeding on corn. The larvae feed on the leaves at their base, and are often found in the whorl in the top of the plant. Mr. Stone found some on corn in Tolland County, July 31, and in Hartford County, August 14, but they were not very abundant in cornfields.

There was a local outbreak, however, in the town of Woodbury, where a field of oats was infested with larvae. Mr. Chamberlain visited the place on August 19 in company with the Litchfield County Agent, who reported the case to this office. On that date the oats had been cut and raked into windrows. There were many full-grown larvae beneath the straw, and many pupae were found in the soil. An adult moth was also received from Southport on September 24.

The army worm has two or possibly three broods each season, the eggs being laid on the leaves of grass or grain. The larvae reach maturity in from twenty to thirty days.

Crosby and Leonard\* state that the insect passes the winter as a partially grown caterpillar. The full-grown larva is about

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\* Manual of Vegetable-Garden Insects, page 289, 1918.

one and one-half inches in length, ground color greenish black, striped lengthwise with dark mottled broad and fine white lines. The appearance of the caterpillars is shown on plate XXVI.

A more extended account of the army worm may be found in the Report of this Station for 1914, page 157. In case of an outbreak, it is often necessary to plow a deep furrow with perpendicular side opposed to the line of advance; to plow and harrow the soil just after the caterpillars transform to kill the pupae; arsenical poisons may be applied to any crops not used for food or forage in order to insure them against injury.

### THE SMEARED DAGGER MOTH.

*Acronycta (Apatela) oblinita* S. & A.

The first larva of this species found feeding on corn was collected at Brooklyn, July 8, by the writer, in company with Messrs. Irving W. Davis and George D. Stone. Mr. Stone sent specimens to the office, later, as follows:—Windham County, July 17: New London County, July 23: Tolland County, July 31: Hartford County, August 14.

This caterpillar is brown and hairy. The young ones resemble those of the fall web-worm, though somewhat lighter and more yellow in color. As it passes through its molting stages, it soon takes on a different appearance. In one of these stages—perhaps next to the final one—it has broad longitudinal brown stripes with a narrow dorsal stripe and two broader lateral stripes of yellow. In its final larval stage it is simply a brown hairy caterpillar about one and one-half inches in length and somewhat resembles the larva of *Diacrisia* which is called the “woolly bear.”

The adult is a pretty gray moth measuring rather more than two inches from tip to tip of fore-wings, shown on plate XXVII, b. The fore-wings are gray, marked lengthwise with black dashes, and the rear wings are white except for a marginal row of small black dots.

One of the immature caterpillars feeding upon corn is shown on plate XXVII, c. They devour the leaves and are usually near the base of the topmost leaves at the time the tassel first begins to show. Later they may feed anywhere on the upper part of the plant. This insect is probably not a serious pest of corn in

this part of the country, but attacks the crop occasionally and causes slight injury.

The caterpillars have a long and varied list of food plants including smartweed (*Polygonum*), cat-tail flag, willow, poplar, peach, apple, pear, strawberry, raspberry, blackberry, grape, bean, cotton, asparagus, buckwheat, wheat, oak, hazel, elm, alder, butter-nut, pine, button-bush, soft-maple, lilac, canna, honeysuckle, clover, corn and grasses. Forbes\* records two broods in a season in Illinois, but states that it is single brooded in Canada. A specimen in the Station collection was reared from a larva feeding on white pine in Norwich, collected July 19, 1916, and the adult emerged May 26, 1917. A larva was collected on cat-tail flag, East Haven, July 19, 1908.

This species occurs throughout the eastern United States and Canada, and the larva is sometimes called "the smartweed caterpillar." It is not sufficiently abundant in Connecticut to require treatment.

### THE LINED CORN BORER.

#### *Hadena semicana* Walk.

Early in the season, a circular letter was received from Dr. E. P. Felt, State Entomologist, Albany, N. Y., stating that the lined corn borer *Hadena fractilinea* Grote had been found in a number of fields in New York state. Consequently we were watching for it and on June 16, one larva was received from Farmington, which seemed to answer the description of *H. fractilinea*. This larva was less than an inch long, and striped lengthwise with brown and white as shown on plate XXI, a. Another was found on corn in Bloomfield June 19. In both cases these larvae were feeding upon the leaves and had not begun to tunnel in the stalk. From the Bloomfield specimen an adult emerged August 9, which seems to resemble *Hadena semicana* more closely than *H. fractilinea*, as it does not have the pale color all along the inner margins of the fore-wings.

*H. semicana* Walker is mentioned in the Yearbook, U. S. Department of Agriculture for 1905, page 634, as follows:—"Hadena semicana Walk. usually classed among the rarer cutworms, occurred in destructive abundance in Mercer County,

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\* Twenty-third Report Illinois State Entomologist, page 170, 1905.



Pa., during June. A similar outbreak occurred in 1893, in an adjoining county in Ohio."

## THE CORN EAR WORM.

### *Heliothis obsoleta* Fabr.

This is the same insect that is so common in the southern states where it is known as the "cotton boll worm," and the "tomato boll worm," because it eats holes into cotton bolls and ripening tomatoes.

It occurs nearly every year in Connecticut, and feeds upon the tips of the immature ears of late maturing sweet corn and field corn late in the season. Sometimes it is locally abundant, and considerable damage results from its attack, but in general the injury is much less severe in Connecticut, which approximates the northern limits of the species, than farther south, where several generations occur. Apparently there is only one brood annually in Connecticut.

That it occurs throughout the state is evidenced by material received from the following localities:—New Haven, Cheshire, Bethany, Northford, Westport, Wilton, Kensington, Rockville, Colchester and New London.

This insect was formerly known as *Heliothis armigera* Hbn., and it is treated under this name in much of the literature of the species.

In Connecticut the moth lays its eggs on the silk of the corn plant, and the young caterpillars feed upon the silk and soon work their way through the husk and devour some of the unripe kernels at the tip of the ear. Sometimes the injury may extend half way down the ear or even to its base, but this is unusual, and in most cases is limited to the tip of the ear. Many eggs are doubtless laid on the silk, and sometimes five or six caterpillars begin to feed there, but they devour each other, so that finally not more than one or at most two remain on an ear. This insect attacks both sweet corn and field corn, but seems to prefer the former and injures it more severely. On October 8, the writer observed sweet corn on sale in the market of Washington, D. C., nearly every ear of which contained a large caterpillar.

The corn ear worm much resembles a cutworm to which it is closely related. When fully-grown it is one and one-half inches

or more in length, and in color it varies widely from light green to a rather dark brown. It is usually striped lengthwise with lighter and darker stripes, but the markings also vary greatly and the most conspicuous stripe is a pale lateral one in the region of the spiracles or breathing pores.

When mature the larva goes into the ground, and in a burrow a few inches below the surface transforms to a smooth brown pupa, slightly less than an inch long. In Connecticut the winter is passed in the pupa stage, but in the southern states where several broods occur, the pupal period varies from two to three weeks.

The adult moth has a wing-spread of about one and one-half inches, ground color of fore-wings buff, with darker brown markings. The markings usually consist of a discal spot and sub-terminal bands, but there is great variation; fringe buff or light brown. The rear wings are cream-color with a broad cross band of dark brown next to the cream-colored fringe. Head, thorax, abdomen, legs and antennae buff like ground color of the fore-wings.

The appearance of an infested ear and the adult moth are shown on plate XXVIII.

There is no good method of controlling the corn ear worm on field corn, but experiments in New Jersey show that on sweet corn it may be held in check by dusting the silk soon after it appears with powdered arsenate of lead and fine sulphur, equal parts. Early planted fields and early maturing varieties usually escape injury. Fall plowing of badly infested fields is to be advised.

## OTHER INSECTS ATTACKING CORN IN 1919.

### THRIPS.

On June 24, some corn plants were received from Mr. A. G. Davis, Litchfield County Agent, which had been injured by thrips. Some of the insects had been collected and mounted on a microscope slide, and submitted with the plants. This mounted material was divided and a part sent to the Bureau of Entomology at Washington, D. C., where it was identified by Mr. A. C. Morgan, who stated that the slide contained two species,—“two

females of the grass thrips *Anaphothrips striatus* Osborn, and one female of *Plesiothrips (Thrips) perplexus* Beach. Practically nothing is known concerning the habits of the last named species." Apparently all the other specimens from Litchfield represent the grass thrips, which is doubtless the species responsible for the injury on corn.

Similar injury to corn caused by thrips was received from Putnam, June 28, and from West Hartford, July 5; it was observed many times by members of the staff in examining corn-fields in various sections of the state. As a rule the injury was not very severe, but confined to a few of the lower or outer leaves on a plant here and there. The surface of the leaf was grooved in white lines in the manner shown on plate XXIX, a, and the injured leaves withered and died very quickly. Treatment would not be practicable in the field, but in the home garden a spray of soap and nicotine solution would rid the plants of these minute insects.

#### WIREWORMS.

Corn plants were received on June 27 from Bristol which had been injured by wireworms, as shown on plate XXIX, b. The base of the stalk had been hollowed out and two larvae were present. The species has not been identified. Wireworm injury is occasionally serious and difficult to control, the only practicable measures being cultural ones such as crop rotation, fall plowing and thorough harrowing.

#### NOCTUID CATERpillars.

When examining a cornfield in Hamden, June 30, a green rather stout larva about one inch long with white stripe along each side was taken on corn. No description was made at the time, but it was placed in the insectary and from it was reared on July 9 an adult of *Autographa falcigera* Kirby var. *simplex* Guen. The larva feeds on a great variety of plants chiefly of the cabbage family.

Mr. Stone collected on corn another pale green larva mottled with darker green in Tolland County, July 31, and from it was reared on August 23, an adult of *Mamestra subjuncta* Gr. & Rob. The larva is a general feeder, especially on grasses and weeds.

The writer found in Bloomfield, June 19, a partially grown slender green larva feeding at the base of the corn leaves in the whorl. Its length was about 15 mm., thickness about 2.5 mm., general color grass-green, granular, each segment margined posteriorly on the dorsum with a tinge of yellow. A narrow yellowish stripe extends along each side from head to anal prolegs just below the spiracles. Head, legs and prolegs, green. The body bears a few scattered hairs, which are most pronounced laterally: dorsum almost smooth. Shown on plate XXIX, c.

The same or a similar species was taken by the writer at Brooklyn, July 8, and Mr. Stone observed and sent in specimens from Windham, Tolland, Hartford and Litchfield Counties. Mr. Stone writes that the green larva can nearly always be found upon the upper surface of the leaf and the holes which it eats are irregular. It eats the tender leaves chiefly, and seldom injures the tassel. This larva is somewhat different from that collected in Bloomfield, but may represent a later instar of the same species. Each is about 25 mm. long, 4 mm. thick, and there are faint longitudinal green lines of lighter and darker shades on the dorsum. The lateral stripes also vary from yellow to white and some even show a pinkish tint.

Though some of these larvae went into the ground in July to pupate, no adults have yet been reared, so the identity of the species is unknown.

Some small zebra caterpillars, *Mamestra picta* Harris, were found feeding upon corn at the Station farm Mount Carmel, June 20, by Mr. Zappe. They were brought to the insectary and adults emerged August 25. These caterpillars feed in clusters when young. When mature they are about two inches long, black or dark brown, strikingly marked with yellow. The adult has a wing-spread of one and one-half inches. The thorax and fore wings are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

This insect is a general feeder and we may expect to find the caterpillars feeding upon almost any garden or field crop.



## THE PARSNIP WEB WORM.

*Depressaria heracliana* Linn.

On June 23, Mr. G. M. Coddington brought to the laboratory some stems of cow parsnips collected in the vicinity of Danbury by Fairfield County Agent L. A. Bevan. The stems had been hollowed out by the larvae burrowing in them, and when received contained several pupae as shown on plate XXX, c.

On July 16 several adult moths emerged: they have a wingspread of about one inch, with fore-wings of buff or light brown marked by short longitudinal dashes of dark brown or black: rear wings lighter brown, but with a suffused darker shade near the distal margin. Shown on plate XXX, b.

This insect passes the winter as an adult under loose bark and in other sheltered places, and the eggs are laid in May or June on the leaves. The young greenish yellow caterpillars web together the leaves and devour the unfolding blossom buds. This is quite a serious pest in fields where parsnip and carrot seeds are grown. The mature caterpillar is slightly over half an inch in length, greenish yellow in color, somewhat paler laterally and ventrally, with head, legs and cervical shield shining black. Each thoracic and abdominal segment bears black tubercles, with a hair arising from each. Shown on plate XXX, b.

When nearly mature, the larva leaves the web and enters the stalks, usually through the axil of a leaf and for the rest of its larval existence tunnels inside the stem. The pupa is about half an inch long, with dark brown thorax and light brown abdomen, and is formed inside the stalks. The moths emerge in about three weeks, and there is only one generation each year.

The native food plants are wild carrot, wild parsnip, cow parsnip and other plants of the family Umbelliferae. Messrs. Zappe and Chamberlain collected this insect in stems of wild parsnip in Goshen, July 6. Mr. Zappe observed it on seed parsnips in his garden in Hamden, and from a letter I am sure that the same pest was injuring plants in a garden in Stratford, though the infested plants had been removed prior to a visit by Mr. Walden on June 30.

The only control methods are to remove and destroy occasional infested plants, and after blossoming, the plants may be sprayed or dusted with arsenate of lead.

## MOSQUITO WORK IN 1919.

BY B. H. WALDEN.

In 1919 the ditches on the salt marshes which have been drained to eliminate mosquito breeding were maintained as in 1918. This includes approximately 5,000 acres located in the towns of Madison, Guilford, Branford, East Haven, New Haven, Orange and Fairfield. In most of the towns it was possible to obtain the same men that were employed in 1918, although it was necessary in certain cases to pay somewhat higher wages.

The ditches were all gone over in April and May and obstructions removed and the necessary cleaning done to provide good circulation of the water.

During the first half of the season the marshes were comparatively dry and free from breeding. Conditions throughout the latter half of the season, however, were extremely favorable for mosquito breeding. Frequent rains and high tides kept the depressions in the marshes filled with water for periods sufficient to produce extensive mosquito breeding.

An attempt to control this breeding by the means of additional ditching and oiling would have increased the cost of maintenance to more than one dollar per acre, which is the maximum amount that can be expended under the law.

**Legislation.** Under the law passed in 1917 providing for the elimination of mosquito breeding places,\* some of the towns have objected to paying three-fourths of the supervision charges in addition to three-fourths of the labor for maintenance. Furthermore, it has been more or less of a question as how to divide these expenses among the various towns as the amount of supervision in a town depends upon the character of the marshes and the judgment of the men employed in carrying out the work. It was undoubtedly the intentions of those drafting the bill for this law that the cost of supervision be paid directly by the State.

Section 2410 of the General Statutes was therefore amended by the 1919 Legislature to read as follows:—

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\* Seventeenth Report Connecticut State Entomologist, page 345, 1917.

## CHAPTER 21.

## AN ACT CONCERNING MOSQUITO BREEDING AREAS.

*Be it enacted by the Senate and House of Representatives in General Assembly convened:*

Section 1. Whenever any swamp, marsh or other land has been drained to the approval of said director, he shall keep the same in repair and free from obstruction, and construct or repair tide gates or otherwise treat such areas so as to make such work effective. The cost of such maintenance or treatment, not exceeding in any year one dollar per acre, shall be paid by the state, and the town, city or borough within which such place or area is located shall reimburse the state for three-fourths of the amount so expended. Said director shall certify to the comptroller the amount due from any town, city or borough under the provisions of this section, and the treasurer of such town, city or borough, as the case may be, shall pay to said comptroller such amount. All amounts so collected shall be available for expenditures under the provisions of this section. Said director may appoint one or more deputies to supervise the work done under the provisions of this and the preceding section, who may exercise the authority granted to such director, and the expense of said director and said deputies for supervision and inspection shall be included in computing the cost of any such work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the state and paid from the funds appropriated for the purpose. The comptroller may advance to said director such amounts, within the appropriation therefor, as are necessary to meet the current expenses for labor authorized under the provisions of this and the preceding section. Any person obstructing the work of examining, surveying or ditching or otherwise treating such mosquito breeding areas, or obstructing any ditch, canal or drain, or the natural outlet of any marsh forming, mosquito breeding areas, shall be fined not more than one hundred dollars or imprisonment not more than ninety days or both.

Section 2. This act shall take effect from its passage.

Approved March 19, 1919.

## REPORT OF WORK BY TOWNS.

**Madison.** The selectmen as in 1918 transferred Mr. Russell Bartlett from the road work to mosquito maintenance from April 14 to September 12. The ditches were cleaned in the spring and attention given them as needed throughout the summer. It was necessary to reopen the outlets of the creeks along Madison Beach at frequent intervals.

**Guilford.** The ditches were cleaned in the spring by Mr.

Frank Blatchley, who has been furnished by the selectmen for the past two seasons. Although the ditches were gone over two or three times during the season, more labor than was available was needed during portions of the season. The tide gate installed on the Great Harbor marsh in 1918 greatly improved the conditions on the marsh during the past season.

**Branford.** Mr. L. E. Rice was again in charge of the mosquito work in Branford. Owing to insufficient labor to thoroughly clean the ditches on some of the marshes in 1918, an extra amount of work was necessary this season. The ditches on the Hotchkiss Grove marsh were considerably damaged by musk rats and required extra work to put them in shape.

**East Haven.** The maintenance work in this town was done in connection with the New Haven work.

**New Haven.** Laborers were hired by the writer to clean the ditches in the spring. Mr. Draper, after finishing his college work in June, was again employed on the work for the remainder of the season.

The city of New Haven is constructing new tide gates on the West River at Congress Avenue bridge, and a new sewer is being laid in Westville, two improvements which should greatly improve the mosquito breeding conditions in the western part of the city. The tide gates which are nearly completed have the abutments and frame work of reinforced concrete with gates of double three-inch tongue and grooved planks and hung with special hinges. These gates control the water on about 130 acres of marsh between Congress Avenue and Chapel Street ditched in 1917,\* which has been flooded much of the time during 1918 and 1919.

The new sewer in Westville will receive the pollution from several factories which for a number of years has been emptied into the upper portion of the West River, causing extensive breeding of *Culex pipiens*†.

**Orange.** The maintenance work in Orange was continued under the direction of Dr. Phelps. In addition to cleaning the

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\* Seventeenth Report Connecticut State Entomologist, page 349, 1917.

† Thirteenth Report Connecticut State Entomologist, page 245, 1913.



ditches, the creek that runs into the cove marsh was cleaned for several hundred feet to the north, thus draining a semi-fresh water swamp that was a possible malarial mosquito breeding area.

**Fairfield.** Mr. Nicholas Matiuck was continued in charge of the mosquito work in Fairfield. The large amount of fresh water mosquito work which is being done in the town requires more attention than the twelve hundred and fifty acres of salt marsh. To adequately handle this problem requires a larger appropriation than has been available in the past.

In the western part of the village of Fairfield is a section known as the Thorpe estate, a low area which was divided into building lots and a number of houses have been built by laborers. The natural drainage was cut off by three streets across the area, and by property owners filling in portions of the main ditch. *Anopheles* larva have been found in the water that collected in rainy weather, and the only method of preventing mosquito breeding was by oiling.

During the past season the old ditch was re-opened and deepened throughout this area and for several hundred feet beyond where it joined a creek in the salt marsh. Tile drains were placed across the three streets: 50 feet of eighteen inch and 140 feet of 12 inch tile was used. A gate was placed on the outer culvert to prevent high tides from flooding the area.

No new mosquito control work was done under the state law during the year, although the writer by request examined marsh areas and made recommendations regarding mosquito elimination in the towns of Westbrook and Groton. In the latter town plans have been made and funds are being raised to drain fifty or sixty acres of salt marsh at Groton Long Point during next season.

#### COST OF MAINTENANCE WORK FOR 1919.

|                                                        |            |
|--------------------------------------------------------|------------|
| Madison .....                                          | \$505.38   |
| Guilford .....                                         | 432.28     |
| Branford .....                                         | 409.22     |
| East Haven .....                                       | 25.62      |
| New Haven .....                                        | 804.97     |
| Orange .....                                           | 200.97     |
| Fairfield .....                                        | 1,217.32   |
| Total .....                                            | \$3,595.76 |
| Average cost per acre .....                            | .727       |
| Expenses in connection with proposed<br>new work ..... | \$15.07    |

## ENTOMOLOGICAL FEATURES OF THE SEASON.

The winter of 1918-1919, unlike the preceding, was unusually mild. There was little snow and the temperature was seldom below zero. Honey bees and native bees which winter-killed severely in 1917-1918, came through the winter nicely and scarcely needed the protection which most of the beekeepers gave their colonies on account of the losses the preceding winter.

The planting season opened late and cold, and plant development and consequently insect development was some two weeks behind that of normal seasons. During June the rainfall was somewhat below normal, but from the middle of July until the end of October, heavy and frequent rains kept the soil soaked with water and many crops needed sunlight. The total rainfall for the season was about six inches more than normal.

Orchard aphids caused considerable injury throughout the state.

Canker worms were present in some localities, but the tent caterpillar was scarce, only a few nests being observed.

The white-marked tussock moth was present, but this and other tussock moths were much less abundant than in 1918.

The potato flea-beetle was abundant and caused considerable damage as in 1918.

The potato aphid was present in small and in moderate numbers on potato and tomato plants, but it did not seem to cause much injury and most owners did not spray to control it.

Aphids attacked peas and injured them considerably. The turnip aphid was also present and injured many small turnip plantings.

The elm leaf beetle was present in injurious numbers and in several towns the trees were sprayed where this practice has been abandoned for several years.

Two of the most conspicuous entomological features of the season were the severe attack on beans everywhere by the green clover worm, and the unusual prevalence of corn borers and other insects attacking corn.

A native borer *Pyrausta ninsliei* Hein., which we may call the smartweed borer, was found in corn stalks in Milford in March, and was thought to be the European corn borer, until the adults were reared in July when it was identified. The stalk borer was very abundant especially in corn and was present in all parts of the state and caused considerable injury.

*Crambus praelectellus* Zinck. attacked and ruined a small field of corn in New Haven, this being the first instance on record of any real damage being caused by this insect.

The corn ear-worm was responsible for a moderate amount of injury to corn. Specimens were received from various parts of the state, and it was observed in many other localities.

A search was made for larvae and injury of the oriental peach moth *Laspeyresia molesta* Busck, in Stamford where it was found in 1918, but no trace of it was discovered.

The brown-tail moth, though slightly more abundant than in 1918, is still scarce.

The gipsy moth has been well held in check. The number of infestations is now less than half that of a year ago, and if there is no wind-spread the coming spring, it is expected that the number of infestations will again be materially reduced.

On account of the excessive rainfall, it was difficult to prevent the breeding of mosquitoes, and there were some complaints, even where the salt marshes have been ditched. The rain barrel or house mosquito was particularly troublesome and had a chance to breed in pools and receptacles everywhere, as the constant rains prevented these breeding places from becoming dry.

#### MISCELLANEOUS INSECT NOTES.

**Enchenopa binotata Say, Reported as Injuring Beans:—**On July 16, specimens of this peculiar bug were received for identification from Stamford, where it was said to be causing injury to garden beans. This species commonly occurs on "bittersweet" *Celastrus scandens*, and is occasionally found on black locust.

**Poultry Food Infested with Mites:—**On August 22, a sample of poultry food was received from Winsted, which was thoroughly infested with mites. This mite was identified by Dr. Philip Garman of this department as *Tyroglyphus farinae* Deg., a species often occurring in food products.

**A Weevil Breeding in Stems of Pigweed and Ragweed:—**Stems of red-root pigweed, *Amarantus retroflexus*, and ragweed, *Ambrosia artemisiaefolia*, infested with larvae were collected in

Wethersfield February 7. On June 12 a large number of weevils emerged from the stems and were identified as *Baris scolopacea* Germ.

**Borers in Stems of Evening Primrose:**—Mr. Walden collected stems of evening primrose, *Oenothera biennis*, in Orange, February 20, which contained in the pith a large number of small yellow larvae. On July 17, a number of small white and brown moths emerged from the stems. These were identified as *Mompha eloisella* Clem.

**Plum Curculio in Peaches:**—Mr. Zappe gathered some unripe peaches at Sound Beach, Stamford, on June 23, which were infested by small larvae. Several infested fruits were also received from Mr. Stancliff Hale, South Glastonbury, on June 16. Adults of the plum curculio, *Conotrachelus nenuphar* Herbst, emerged July 23 from the Glastonbury material.

**Leopard Moth in Hartford:**—On July 9, a girdled and broken elm branch was received from the Superintendent of trees in the city of Hartford. Without question this was the work of the leopard moth, *Zeuzera pyrina* Linn., which though common enough along the coast has never before been found so far inland in Connecticut, or I think elsewhere in this country.

**The Potato Aphid:**—So much damage was caused in 1918 by the potato aphid, *Macrosiphum solanifolii* Ashm., that we expected recurring injury in 1919. The species could be found in small numbers in many fields, of potatoes and tomatoes, but in most cases it was not sufficiently abundant to do much damage, and the writer did not learn of a single case where fields were sprayed on account of it.

**The Gladiolus Aphid:**—On June 17, some gladiolus corms infested with immature aphids, were received from Bristol. These corms had been stored over winter. One of them was planted in a pot in the insectary and soon began to grow, but the aphids multiplied so rapidly that the plant was soon killed. Plate XXXII, a, shows the appearance of the plant when literally covered with aphids. This is known as the gladiolus aphid, *Aphis gladioli* Felt.



**Abundance of the Pea Aphid:**—On June 6 and 13, pea vines were brought to the office from the vicinity of New Haven, infested by the pea aphid, *Macrosiphum pisi* Kalt., with the report that this aphid was doing great damage to garden peas. In the large truck fields, no treatment is usually practiced in Connecticut. In the home garden, spraying the vines, especially the under sides of the leaves, with nicotine solution and soap will hold this pest in check. Even a forceful spray of water from the hose will knock them off and many will fail to get back to the leaves. If this is repeated every few days, little harm to the plants will result.

**Swarms of White Moths:**—For two or three nights about September 19, there were great numbers of large white moths with dotted black markings, around the electric lights in New Haven, and doubtless in other towns and cities of Connecticut. This is called the "chain-dotted geometer," *Cingilia catenaria* Drury, and the larvae feed upon the leaves of sweet fern and bayberry. The larvae were very abundant in 1903, and again in 1919, especially in Windham County, where many sweet fern and bayberry bushes were stripped.

**Pink Grasshoppers:**—A pink form of one of the so-called angular winged grasshoppers or katydids, *Amblycorypha rotundifolia* Scudder, was brought to the Station on August 20, from Orange where it was collected by Mrs. George D. Bathgate. The specimen was a female. On August 12, 1918, a pink female of *Amblycorypha oblongifolia* Deg., was received from New Haven, collected by Miss Molly Hart. On September 21, 1914, two specimens of *Scudderia furcata* Bruner, were received from Derby and a note regarding them was printed in the Report of this Station for 1914, page 187. The adults of these species are normally green, but occasionally the pink forms occur.

**Larch Case Bearer:**—On August 14, Dr. G. P. Clinton, botanist of this Station, handed the writer some larch twigs which he had collected in Greenwich. The leaves had been mined at the tips by the larvae and had turned brown. There were several of the characteristic cases on the leaves. The insect is an European species known as the larch case bearer, *Coleophora*

*laricella* Hubner, and it has been recorded from different parts of New England at various times as causing considerable injury. There is only one generation each year, and the adult is a small gray moth which emerges early in June and July. The winter is passed by the larvae which rest in their cases attached to the bark of the twigs. This insect can doubtless be controlled by spraying with arsenate of lead which has been found effective against the closely allied case-bearers on fruit trees.

**The Pine Tube-Moth:**—While inspecting nursery stock in Hartford in October, Mr. Zappe observed some large white pines growing near the nursery with many of the leaves fastened together to form cases or tubes inside of which the larva feeds. This is the work of the pine tube builder, *Eulia pinatubana* Kearfott. The larva is about one-third of an inch long, pale green with light brown head. The adult is a small moth with a wing-expanse of slightly more than half an inch, and with forewings of a dull rust-red color, crossed by two oblique parallel paler bands: rear wings are silky gray. The tube is formed of about fifteen needles fastened together with silk threads as shown on plate XXXII, b. There is probably one brood each season. The insect is not of great economic importance, but if it should prove injurious to choice ornamental trees, spraying with lead arsenate will doubtless be effective in holding it in check.

**The Clover Seed Chalcid:**—On August 4, Mr. Pelton of the Station Staff brought to the laboratory some seed of a choice hardy variety of clover, which had been procured from Ohio, for seeding in Connecticut. Nearly all of the seeds had a small hole in one side, where some insect had emerged. Many of these seeds were examined and in some were found the dead bodies of a small chalcid fly, which Mr. Walden identified as the clover seed chalcid *Bruchophagus funebris* How. The eggs are laid on the clover heads in the field, the larvae feed inside the seeds and the adults emerge after the seeds are ripe. This insect occurs wherever clover is grown, and there are three broods each year in Illinois. Early cutting of clover is a remedy. The seeds with exit holes are shown on plate XXX, a.

**Swarms of Cotton Moths:**—On October 5, on Chapel and other business streets of New Haven, there were large numbers

of brown moths resting with folded wings on the plate glass store windows. They flew around the lights the preceding evening and in a few days had all disappeared. Specimens were received from Bridgeport, and Dr. Felt informed the writer that swarms appeared in various sections of New York state at about the same time. This is the cotton moth, *Alabama (Aletia) argillacea* Hubner, which occurs in great numbers in the cotton belt of the southern states, and migrates northward in the fall. Occasionally the swarms reach Connecticut before they are dissipated. Such a swarm appeared in New Haven in 1911, and was mentioned in the Report of this Station for that year, page 339.

**Elm Leaf Beetle Again Abundant:**—This insect was formerly very destructive to elm trees in southern Connecticut, but for the past few years has not been much in evidence as a pest. Beginning in 1917, it has increased each year and did enough damage in 1918, so that some communities decided to spray their trees in 1919. Trees were sprayed in West Haven and in Clinton, which were not sprayed the preceding year. Possibly the moist weather during the latter part of July and afterward may have induced the growth of the fungus which attacks the pupae, but it came rather late in the season for the best results, and all communities where trees are menaced should prepare to spray the foliage in 1920.

**Beans Injured by Gray Hair-Streak Butterfly:**—Green slug-like larvae were received from two correspondents in Hartford, on September 15 and 22, respectively, in both cases reported as feeding upon Lima beans. These are the larvae of one of our small butterflies called the gray hair-streak, *Uranotes melinus* Hubner. As a rule, this is not considered a pest in Connecticut, but further south the species is regarded as a minor pest of beans and peas. The butterfly has a wing-spread of one and one-fourth inches, and the wings are blackish with blue-gray tints. Near the tips of the rear wings is a row of bluish spots, with a large orange spot in the center surrounding a small black one, and the rings terminate in slender tail-like processes. There are two broods each year in the north and three in the South. Wherever abundant, this insect may be kept in check by spraying with lead arsenate.

**The White Blotch Oak Leaf-Miner:**—Several complaints were received regarding an insect attacking the leaves of white oak trees, especially in the central portion of the state, and specimens were received from Cromwell and New Haven. Some of the leaves had been crumpled and possibly attacked by more than one insect, but the samples submitted all showed the presence of the white blotch oak leaf-miner, *Lithocolletis hamadryadella* Clemens. This insect makes a whitish blotch-like mine on the upper surface of the leaf, and attacks different kinds of oaks. The larva is very small, flat, and without feet, and brownish yellow in color. It transforms within the mine, and the adult is a small silvery white moth with a wing-expanse of about a quarter of an inch. There are said to be five or six annual broods in the vicinity of Washington, D. C. There is no method of control known, except to gather and destroy the infested leaves.

**Swarms of Aphids:**—On June 23, the writer's attention was called to the swarms of green winged aphids which had for a few days been present on Chapel Street and in other parts of the city. The tops of automobiles and the clothes of persons were literally covered. There were many inquiries at a local seed store, and some persons thought they were seventeen-year locusts. One of the Station employees stated that when riding his bicycle into New Haven on Dixwell Avenue, his clothes were fairly covered with these aphids. Assistants were sent to Chapel Street to collect specimens, and found them to be aphids with heavily-marked wing-veins. Some were mounted on microscope slides and sent to Dr. Edith M. Patch, Agricultural Experiment Station, Orono, Me., who identified the species as *Calaphis betulaecolens* Fitch. This aphid feeds upon birch, is supposed to remain on its host throughout the season, and was extraordinarily abundant all over Connecticut in 1919. Of course there are few birches in the city, but there are many acres of gray or bobbin birches, *Betula populifolia*, in Orange only three or four miles from the center of New Haven, and with the prevailing winds blowing from the southwest, this section was probably their source. Possibly they became so abundant that they were obliged to leave their hosts in search of food. There were a number of newspaper accounts of the incident, some being more startling than accurate.



**Flea Beetle on Swiss Chard:**—On June 28, one larva feeding on swiss chard was received from Salisbury, with the statement that the insect was causing considerable injury in gardens in that vicinity. The larva was about a quarter of an inch long, and covered with black spines which are white at the tips. An adult emerged July 21, and proved to be the spinach flea beetle, *Disomycha xanthomelaena* Dalman. It feeds upon pigweed, beet, swiss chard and spinach, the larvae occurring on the under side of the leaves. When young the larvae feed in clusters, but separate when they are partly grown. They often drop to the ground when disturbed. At first they eat only the epidermal layer, but later eat holes through the leaves. The adult is about one-fifth of an inch long, greenish black with yellow prothorax, and hibernates as an adult. In the vicinity of Washington, D. C., there are two broods annually.

Of course it is not safe to apply poison to any foliage which is to be used for food. Therefore on swiss chard and spinach, it may be possible to spray the under surface with strong soap and water, or to brush the plants just before cultivating. The adults can be caught like the flea beetles by passing over the rows a box lined with tanglefoot.

**An Outbreak of Book Lice in a House at Milford:**—On August 6th, a telephone communication was received at the Station from Milford regarding some very small insects infesting a dwelling house, and from the description, the identity of the insect could not be established. Therefore the writer was sent to investigate. The insect found proved to be a species of book louse, *Atropos pulsatoria* Linn., belonging to the order Corrodentia. The individuals were numerous, being present in all parts of the house, in the cracks of the floors, on the stairs, under rugs, behind pictures, and some were also found on the furniture.

The owner of the house thought that the pest might have been brought into the house on baskets of eggs from the hen houses, which on examination were found also infested.

The injury caused by the insects was more imaginary than real; the housewife was worried because she did not know what the insects were, or how to get rid of them. The only place where they seemed to be doing any damage was on the under side of the

dining room chairs. The chair seats were made of strips glued together, and many book lice were present on the under side, together with some very fine white dust, which the members of the family declared was not there when the chairs were purchased a short time before. There is still some doubt whether the book lice were responsible or whether the wood was powder posted before or soon after being made into chairs.

The treatment advised for the control of this insect was to wash floors and woodwork with hot water and soap and to wipe over the furniture and pictures, etc. with the same. The house was again visited on December 1, and the family reported that the book lice had then all disappeared, but that they were present until the cold weather set in, and probably were not all killed by the treatment. It is probable that the insects may appear again in the spring, and if so, the house will be fumigated with hydrocyanic acid gas.—M. P. Zappe.

#### A Tobacco Warehouse Infested by the Cigarette Beetle:—

On December 31, 1918, there was brought to the Station a handful of choice shade-grown wrapper-leaf tobacco infested with larvae and adults of the cigarette beetle, *Lasioderma serricorne* Fabr. This tobacco came from a large tobacco storehouse, where on the fourth floor several hundred bales of the 1917 crop were stored. The writer visited this storehouse on January 2nd, 1919. Some bales were rather badly infested around the edges and butts.

A local contractor had tried to kill the insects by fumigating with carbon disulphide, first by fumigating the whole room (which was a failure) and, second, by putting a dose on the top end or side of each opened bale. The second method killed some of the insects but did not penetrate sufficiently to prove effective, and those inside were alive after the treatment. Moreover, there was the disagreeable odor of the carbon disulphide discernible in several of the bales, and there was some apprehension that it might affect seriously the quality of the tobacco, which would obviously be ruined for wrapper purposes if the insects were not killed promptly. The storage room was said to contain 93,000 cubic feet.

After a general survey of the situation, I advised heat as the most practical method of treatment. A sweating room opening

out of the large storeroom was at a temperature of 96° F. at the time of my visit. Only two pipes had steam in them and ten more were available. Additional steam coils could be installed if needed to bring the temperature up to the required point.

On January 10th, I made another visit to the warehouse. The heat had been given a trial. Additional pipes were added and the temperature was raised to 148° F. The tobacco bales were placed in the room January 8th and left there over night: they were stacked flatwise with 2 x 4 inch scantling between them to allow for circulation. A thermometer placed inside one of the bales registered 130° F.

Though most of the insects had apparently been killed, there were a few still alive, and one of the owners seemed to regard the treatment as a failure. Considerable material was gathered and brought to the laboratory and examined with the following results:—

|              | Dead | Living |
|--------------|------|--------|
| Larvae ..... | 273  | 7      |
| Pupae .....  | 3    | 0      |
| Adults ..... | 62   | 0      |
| Total .....  | 338  | 7      |

These figures show that 2.56 per cent. of the larvae, or 2.1 per cent. of all stages came through alive. In spite of the fact that some were not killed, this seemed to me by far the best possible method of treatment, and it is probable that if the temperature could have been kept for a few hours longer to allow the bales of tobacco to become thoroughly heated through, it would have killed all the insects. A communication to this effect was sent to the owners, who later were asked about the matter and replied as follows:—"Our treatment to rid ourselves of the cigarette beetle consisted in putting the entire tobacco in one of our sweatrooms and running the heat up to 130° F. At this temperature we left the tobacco in the room for five hours. A day or two later we took all of the packages out of the sweat-room and put them in a building without heat. It so happened that the days following were extremely cold. We have examined any number of the packages from time to time and have found no trace of living beetles or larvae. The bulk of the tobacco has been shipped to the various customers and we have not had a single complaint regarding it."

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## ILLUSTRATIONS.

All plates are from photographs from the following sources:—Plates IX, a, X, b, and the right half of Plate XVI, by W. O. Filley; Plate XI, a and b, by Professor Samuel J. Record; Plate XIII, c, by Harry A. Doty; left half of Plate XVI, by D. B. Pangburn; Plate XIII, b, by Harry B. Kirk; Plates XIV, b, XVIII, a, XIX, b, XX, a, by W. E. Britton; Plates XVIII, b, XXI, a, XXII, b, XXIII, a, XXIV, a, XXV, a, c and d, XXVII, a and c, XXIX, a, b and c, XXX, a and c, by K. F. Chamberlain. All others by B. H. Walden. The text figures are from drawings as follows:—Figure 16 prepared from map by Mr. Walden; figures 17 and 18 by A. B. Champplain; figure 19 by Dr. Philip Garman. Figure 20 from Bureau of Entomology, U. S. Department of Agriculture.

a. Young white pine tree with leader killed by weevil.



b. Young pine tree with leader and some of the lateral branches killed by weevil.



WHITE PINE WEEVIL.

PLATE X.



b. Leader killed by weevil and bark torn away by birds, to get at the grubs.

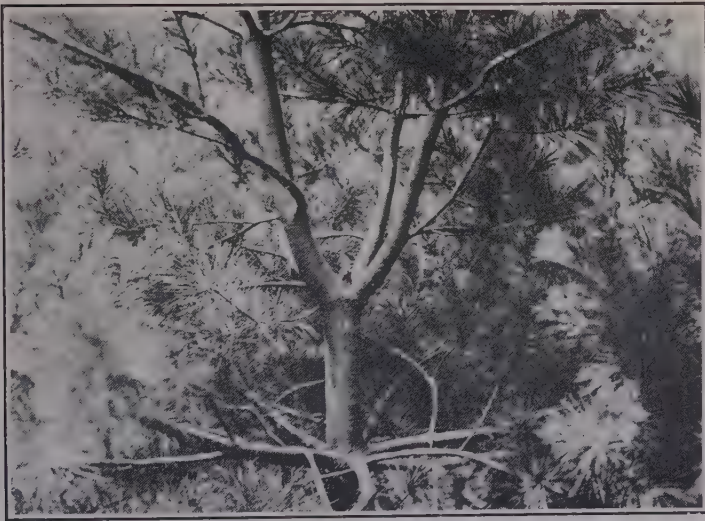


a. Result of weevil injury. This tree has lost its leader several times.

WHITE PINE WEEVIL.



a. All laterals removed except this one, to induce a stronger growth.



b. A forked tree resulting from the loss of the leader by weevil injury.

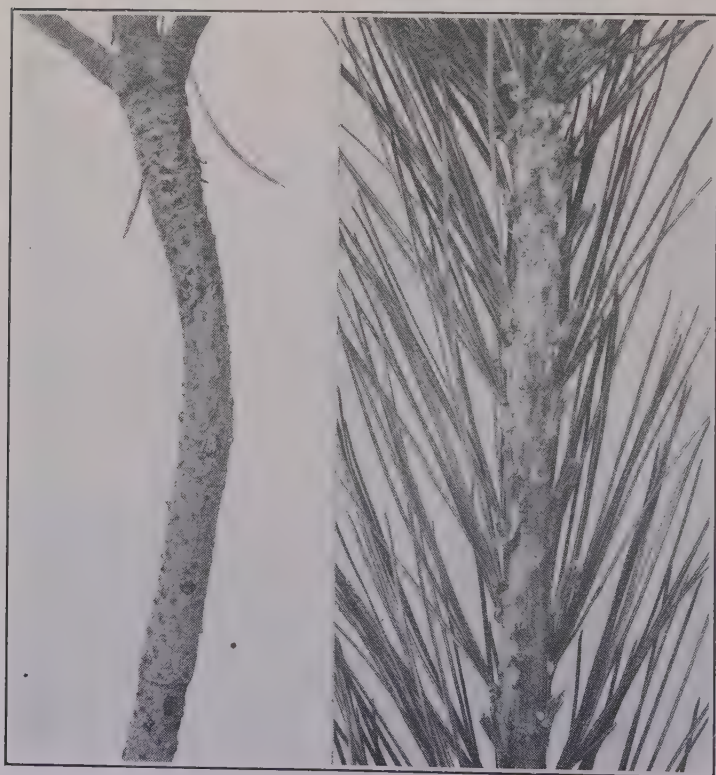
WHITE PINE WEEVIL.



PLATE XII.

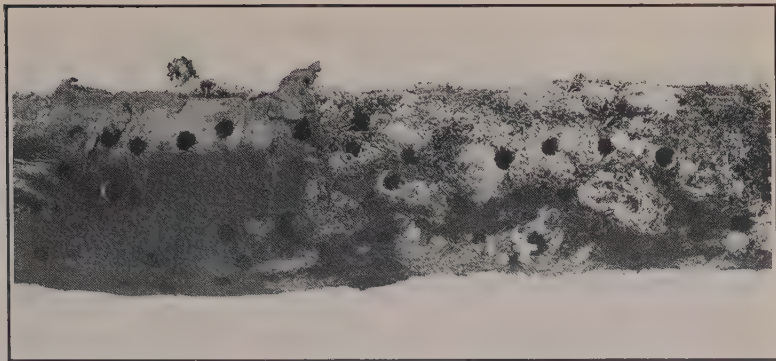


a. The white pine weevil. Adult beetles, four times enlarged.

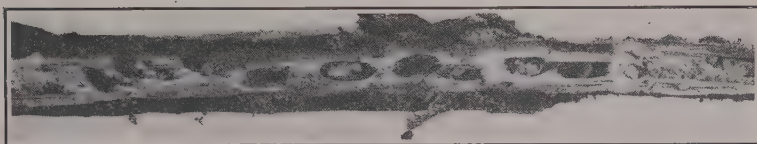


b. Weevil punctures and resin exudation from them. Natural size.

WHITE PINE WEEVIL.



a. Exit holes of white pine weevil. Natural size.



b. Larval cells in pine leader. Natural size.



c. Adults, larva, pupa and cells in pine leader. Slightly enlarged.

WHITE PINE WEEVIL.

PLATE XIV.

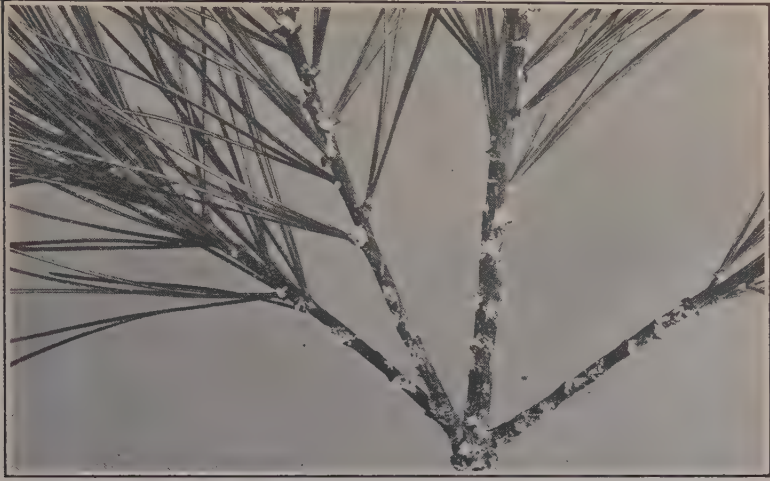


a. Method of collecting weevils in white pine plantations.

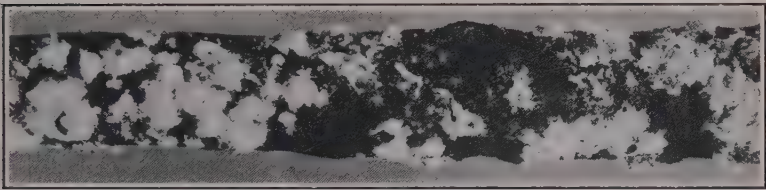


b. Box to hold cut leaders. Wire screen allows parasites to escape but weevils are imprisoned.

**WHITE PINE WEEVIL.**



a. The pine bark aphid in small tufts on twigs and leaves.  
Natural size.



b. Pine bark aphids in larger tufts on twig. Natural size.



c. Method of hand spraying pine trees.

**PINE BARK APHID.**





The pine bark aphid on trunks of trees.

PINE BARK APHID.



a. Automobile truck power sprayer taking water from canal.



b. Spraying woodland trees with automobile truck power sprayer.

**GIPSY MOTH WORK.**

PLATE XVIII.



a. Underspraying beans with nicotine solution and soap.



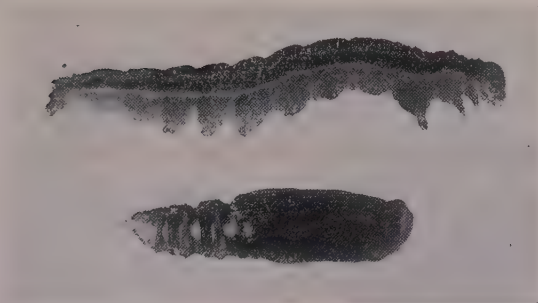
b. Patch of beans in a garden showing injury by the caterpillars.

**GREEN CLOVER WORM.**





a. Larvae feeding upon bean. Natural size.



b. Larva and pupa. More than twice natural size.



c. Adult moths. Twice natural size.  
**GREEN CLOVER WORM.**



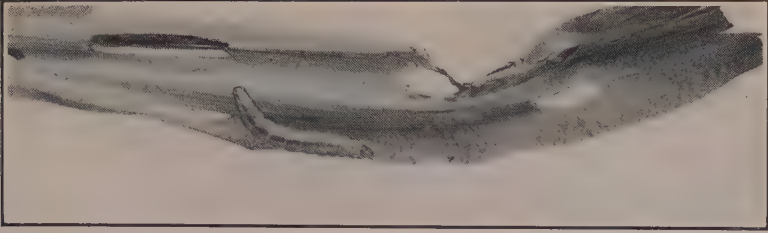


a. Cornfield in Milford, first found infested with larvae.



b. Second field found infested. This is a short distance north and across the street from the field shown above.

**A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.**



a. The lined corn borer, *Hadena fractilinea*. Larva, natural size.



b. *Pyrausta ninsliei* Hein. Adult twice enlarged.



c. *Pyrausta ninsliei*, lateral and dorsal view of larva. Twice enlarged.

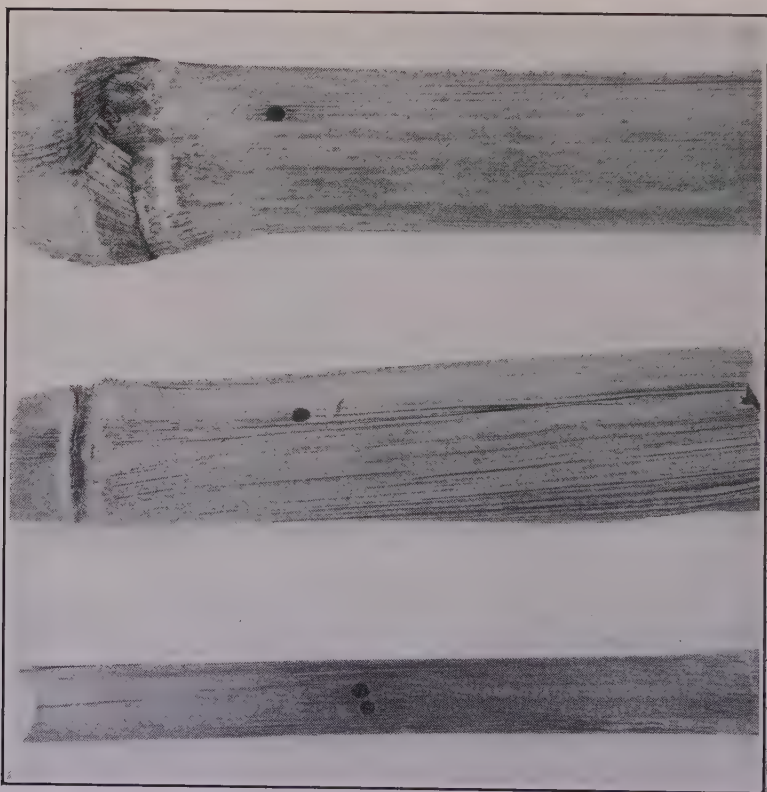


d. Larva of *Pyrausta ninsliei* in burrow in cornstalk. Twice enlarged.

THE LINED CORN BORER, *HADENA FRACTILINEA*.  
A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.

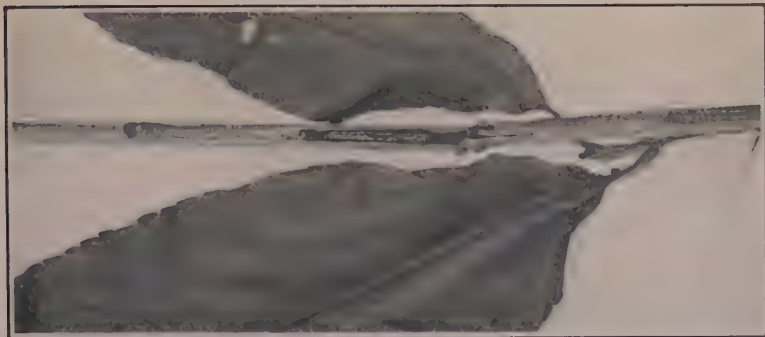


a. Burrows in smartweed, torn open by birds to get at the larvae.  
Natural size.



b. Entrance holes in corn stalks. Natural size.

A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.



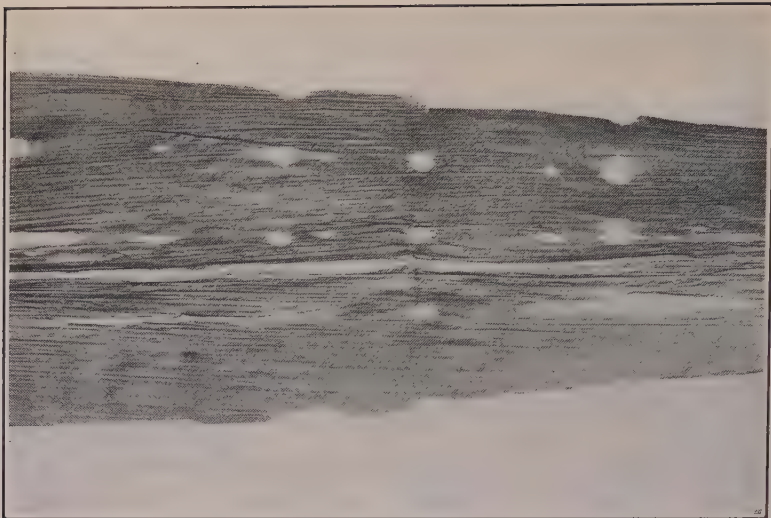
a. Larva in peach shoot growing near ground. Natural size.



b. Burrows in corn stalks. Natural size.

**THE STALK BORER.**





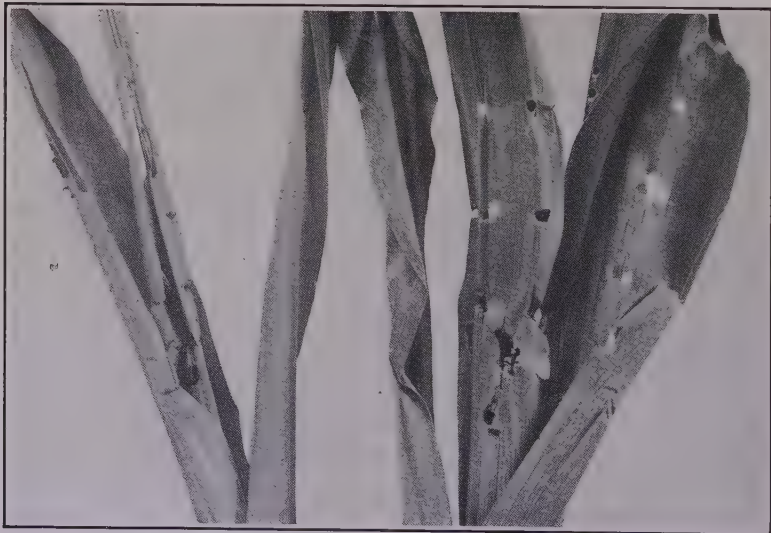
a. Characteristic injury near tip of blade. Holes eaten by larva before leaf unrolled. Natural size.



b. Adult of stalk borer.  
Natural size.



c. Immature stalk borer in corn. Natural size.



d. Characteristic form of injury caused by the young larvae feeding on the unrolled leaves at the whorl. Reduced.

**THE STALK BORER.**



- a. Cornfield ruined by the attacks of the larvae.
- b. Larva and adult. Four times enlarged.
- c. Larval cases on base of stalks. Reduced.
- d. Injury to stalks, cases removed. Reduced.

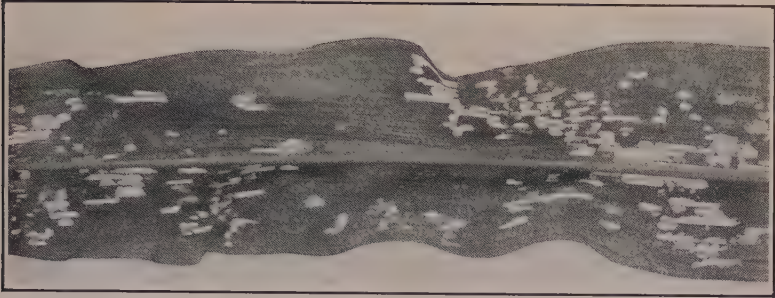
**CRAMBUS PRAEFECTELLUS.**



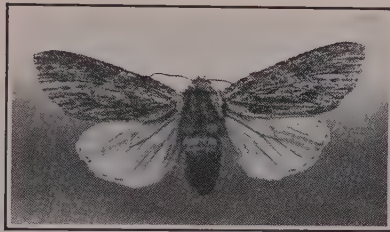
Larvae feeding on corn. Natural size.

**THE ARMY WORM.**

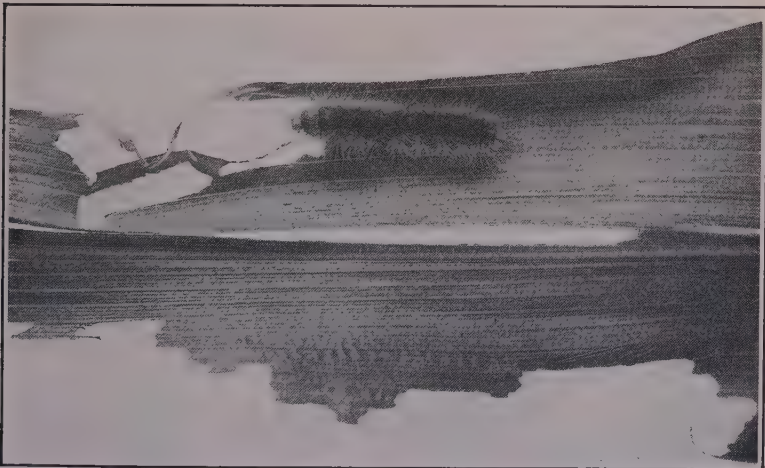




a. Work of young larvae on corn blade. Much reduced.



b. Adult moth. Natural size.



c. Partially grown larva feeding upon corn leaf. Natural size.

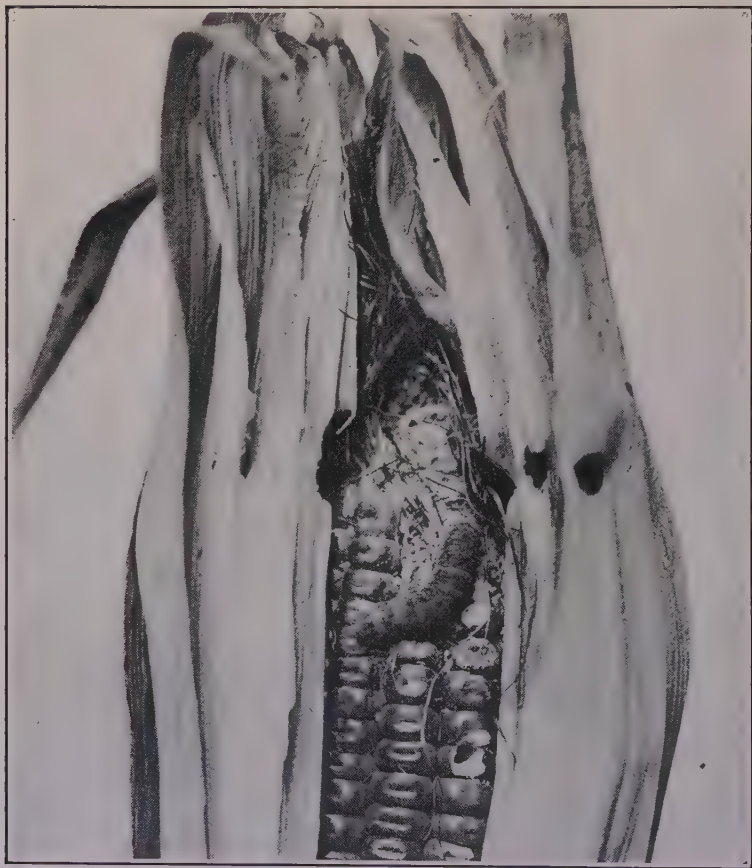
**THE SMEARED DAGGER MOTH.**



PLATE XXVIII.

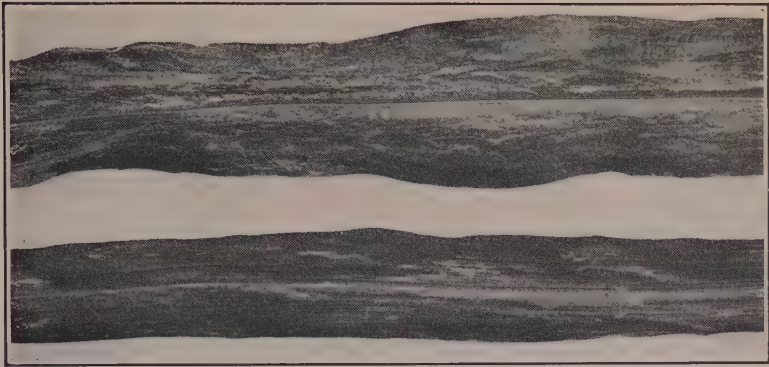


a. Adult moth. Natural size.

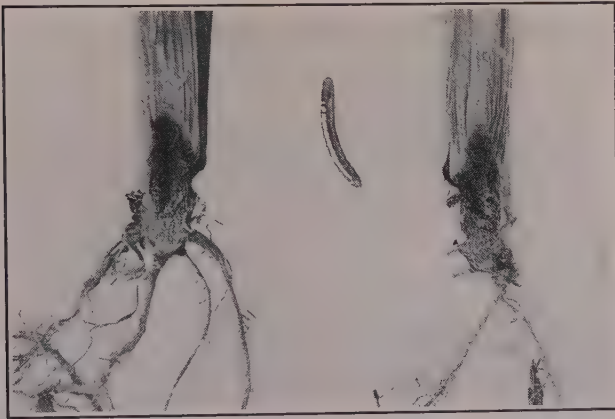


b. Larva feeding at tip of ear of corn. Natural size.

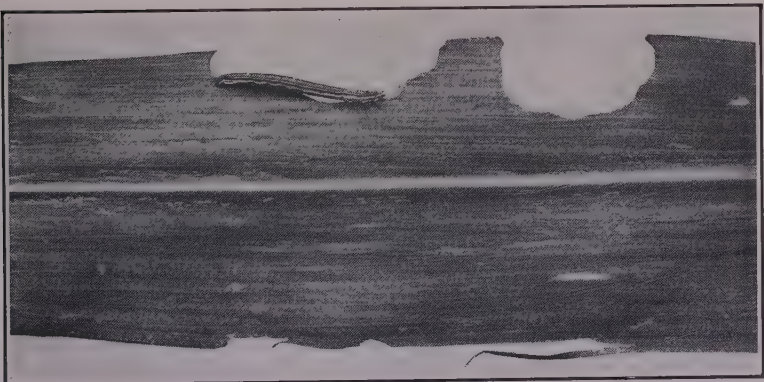
CORN EAR WORM.



a. Injury to leaves by the grass thrips. Much reduced.

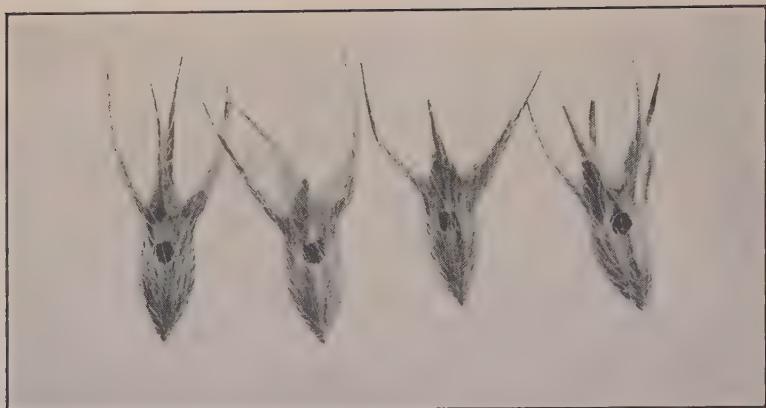


b. Injury by wire worms. Natural size.

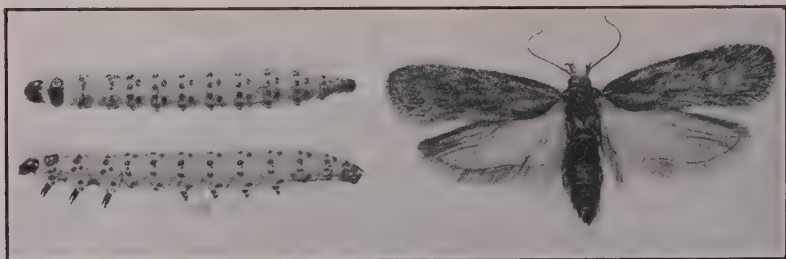


c. A slender green larva feeding upon corn. Unidentified. Natural size.

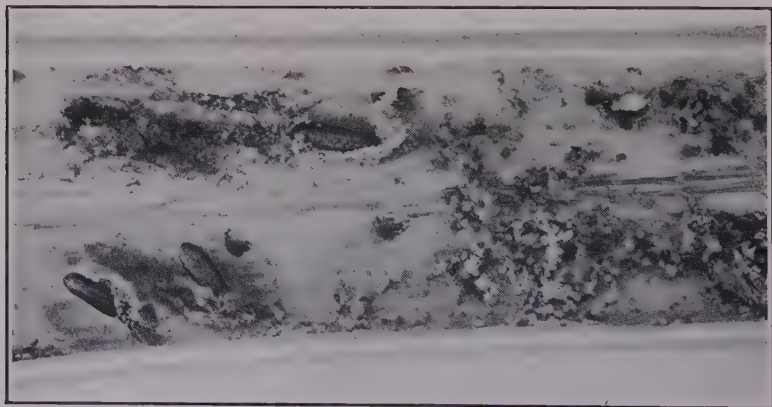
**CORN INSECTS.**



a. Clover seeds showing exit holes of the clover seed chalcid.  
Four times enlarged.

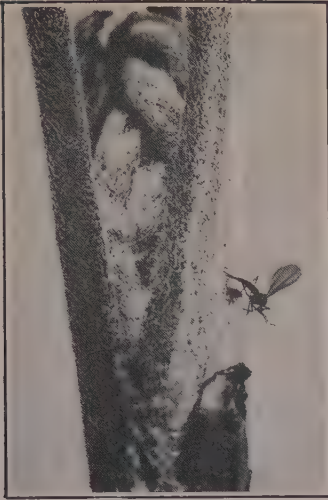


b. Lateral and dorsal view of larva, and adult of parsnip web worm.  
Twice natural size.



c. Inside of stalk of cow parsnip showing pupae of parsnip web worm.  
Natural size.

**CLOVER SEED CHALCID AND PARSNIP WEB WORM.**



a. Adult fly laying eggs.  
Three times enlarged.



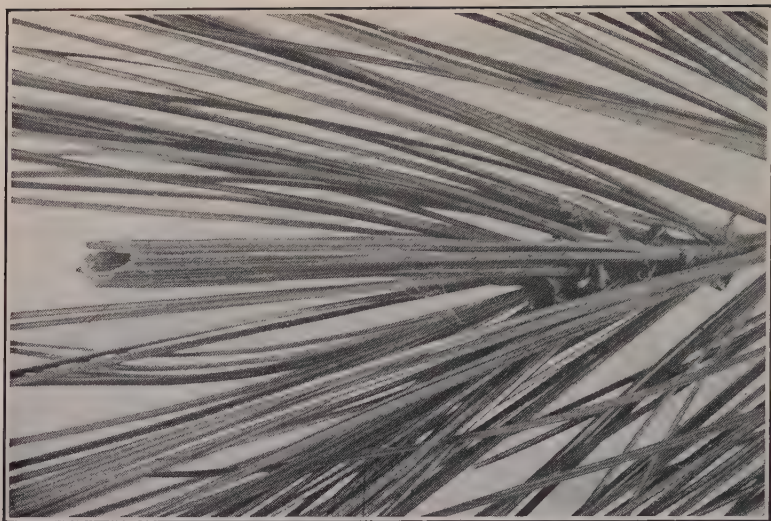
b. Galls on new shoot.  
Twice enlarged.



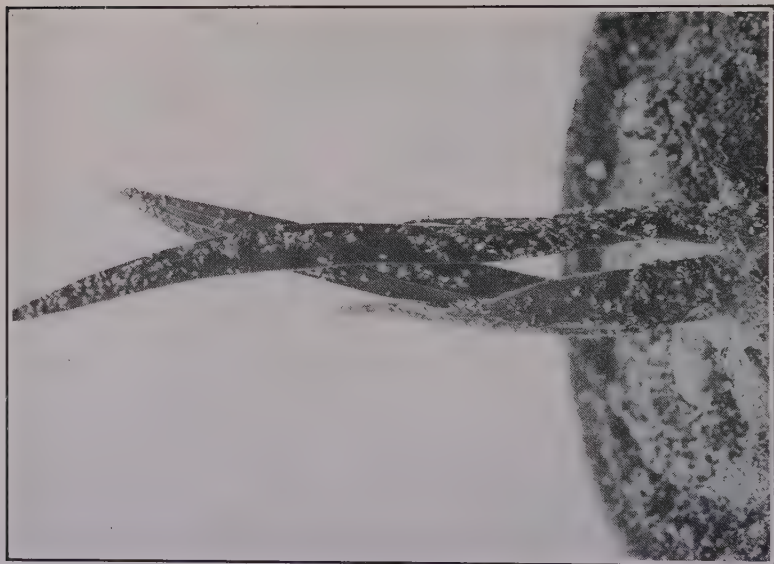
c. Galls on chrysanthemum leaves caused by the chrysanthemum gall midge. Twice natural size.

**CHRYSANTHEMUM GALL MIDGE.**





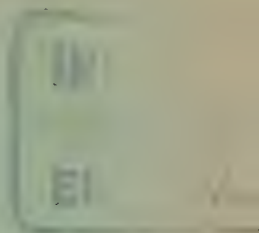
b. Characteristic work of the pine tube builder.  
Twice enlarged.



a. Gladiolus plant overcome by gladiolus aphid.  
Natural size.

PINE TUBE BUILDER AND GLADIOLUS APHID.

Conn. Bull. 224



# Connecticut Agricultural Experiment Station



E. H. JENKINS, Director

## SPRAY CALENDAR

W. E. BRITTON, Entomologist



NEW HAVEN, CONN.

## BULLETIN 224

G. P. CLINTON, Botanist



1921

## CALENDAR

1921

## JANUARY

| S     | M     | T  | W  | T  | F  | S  |
|-------|-------|----|----|----|----|----|
|       |       |    |    |    |    | 1  |
| 2     | 3     | 4  | 5  | 6  | 7  | 8  |
| 9     | 10    | 11 | 12 | 13 | 14 | 15 |
| 16    | 17    | 18 | 19 | 20 | 21 | 22 |
| 23/30 | 24/31 | 25 | 26 | 27 | 28 | 29 |

## FEBRUARY

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    | 1  | 2  | 3  | 4  | 5  |
| 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 |    |    |    |    |    |

## MARCH

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    | 1  | 2  | 3  | 4  | 5  |
| 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 |    |    |

## APRIL

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    | 1  | 2  |
| 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |

## MAY

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    |    | 7  |
| 1  | 2  | 3  | 4  | 5  | 6  |    |
| 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 |    |    |    |    |

## JUNE

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    | 1  | 2  | 3  | 4  |
| 5  | 6  | 7  | 8  | 9  | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 |    |    |

## JULY

| S     | M  | T  | W  | T  | F  | S  |
|-------|----|----|----|----|----|----|
|       |    |    |    |    |    | 2  |
| 3     | 4  | 5  | 6  | 7  | 8  | 9  |
| 10    | 11 | 12 | 13 | 14 | 15 | 16 |
| 17    | 18 | 19 | 20 | 21 | 22 | 23 |
| 24/31 | 25 | 26 | 27 | 28 | 29 | 30 |

## AUGUST

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    |    | 6  |
| 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 |    |    |    |

## SEPTEMBER

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    |    | 3  |
| 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 |    |

## OCTOBER

| S     | M     | T  | W  | T  | F  | S  |
|-------|-------|----|----|----|----|----|
|       |       |    |    |    |    | 1  |
| 2     | 3     | 4  | 5  | 6  | 7  | 8  |
| 9     | 10    | 11 | 12 | 13 | 14 | 15 |
| 16    | 17    | 18 | 19 | 20 | 21 | 22 |
| 23/30 | 24/31 | 25 | 26 | 27 | 28 | 29 |

## NOVEMBER

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    |    | 5  |
| 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 |    |    |    |

## DECEMBER

| S  | M  | T  | W  | T  | F  | S  |
|----|----|----|----|----|----|----|
|    |    |    |    |    |    | 3  |
| 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |



## FOREWORD.

This is the fifth revision of the Connecticut Agricultural Experiment Station's Spray Calendar; the first having been issued in 1904 as Bulletin 142 and others as Bulletins 159, 183, and 199.

The present edition is slightly revised and enlarged. It includes brief descriptions, with preventive measures, of those insects and fungi and of a few lower animals and environmental conditions which most often injure or destroy crops.

Fuller statements concerning these foes will be found under the references given at the end of the various descriptions.

While primarily designed for Connecticut conditions the information is largely applicable to most of the northeastern states.

The enormous amount of damage caused by insects annually in the United States has been estimated at \$1,000,000,000.00 and a similar loss is due to plant diseases. Through proper treatment by spraying and other methods this loss can be greatly reduced. The information given in this calendar will aid you in defeating these enemies. Hang up the Calendar in a convenient place, near your desk, so that it can be consulted as needed. When it comes to treatment of pests, remember the adage, "A stitch in time saves nine." Send specimens and write for further information at any time to

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION,  
New Haven, Conn.

## DIRECTIONS FOR PREPARING INSECTICIDES AND FUNGICIDES.

### FORMULAS FOR INSECTICIDES.

#### LEAD ARSENATE.

3 lbs. (Paste) or 1½ lbs. (Dry) Lead Arsenate and 50 gals. Water.  
Spray upon foliage to kill all chewing insects. May be used with Bordeaux or with lime-sulphur mixture.

#### PARIS GREEN.

1 lb. Paris Green. 3 lbs. Lime.  
100 gals. Water.

Spray upon foliage to kill potato beetle, elm leaf beetle, and all chewing insects. Commonly used with Bordeaux mixture on potatoes, largely superseded by lead arsenate.

#### CALCIUM ARSENATE.

1½ lbs. Dry Calcium Arsenate. 1½ lbs. Dry Air-Slaked Lime.  
50 gals. Water.

Applied as dust or spray on potatoes. May be used in Bordeaux mixture. Not safe on fruit trees.

#### POISONED BRAN MASH.

5 lbs. Wheat Bran. 4 oz. White Arsenic or Paris Green.  
1 pint Cheap Molasses. 1 Lemon. 7 pints Water.

Mix to form a dry mash and scatter around in field to kill cut-worms, army worms and grasshoppers.

#### HELLEBORE.

Dust on the plants, or mix with water, 1 oz. in 2 gals. and spray. For currant-worm and other saw-fly larvae.

#### LIQUID LIME-SULPHUR.

*Winter Spray.* 1 part Lime and Sulphur. 9 parts Water.  
*Summer Spray.*

1¼ to 1½ parts Lime and Sulphur. 45 to 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

#### NICOTINE SOLUTION.

½-¾ pint in 50 gals. Water. Dissolve a 1 inch cube of Laundry Soap and add for a Spreader.

Several solutions are now sold containing 40% or more of nicotine. Excellent for killing aphids and other sucking insects.

#### KEROSENE EMULSION.

2 gals. Kerosene. 1 lb. Common Soap. 1 gal. Water.

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a white creamy mass is formed which thickens on cooling. Dilute *nine* times before using for most aphids, but may be used stronger or weaker.

#### MISCIBLE OILS.

Several miscible oils are on the market, such as "Scalecide" and "Jarvis Compound," for killing San José scale, especially on old apple trees, mix 1 part in 15 parts water.

#### COMMON LAUNDRY SOAP.

Spray 1 lb. dissolved in 8 gals. water upon foliage to kill red spider, aphids, and other sucking insects.

#### CARBON DISULPHIDE.

To kill insects infesting stored grain, in tight bins, use 1 lb. for about 100 cubic feet of space. Expose for about 36 hours.

#### PARADICHLOROBENZENE.

A granular solid chemical which gives off fumes fatal to insect life. Has recently been used successfully to control the peach borer.

#### NAPHTHALENE.

Used in the form of moth-balls and "flakes" to keep clothes moths out of clothing. "Flakes" scattered around the borders of floors and shelves will drive away ants.

#### FORMALIN FLY POISON.

1 tablespoonful Commercial Formalin. ½ cup Sweet Milk.  
½ cup Water.

Mix and expose in a shallow plate with a slice of bread in it. Flies will drink the liquid, especially if no other moisture is accessible, and be killed.

### ANT POISON.

Arsenate Soda 125 grains. Sugar 1 pound. Honey 1 tablespoonful.  
Water 1 quart.

Add arsenate soda and sugar to water. Boil until both are dissolved, then add honey. When cool, place in shallow dishes with a crust of bread or bits of sponge.

### HYDROCYANIC ACID GAS.

1 oz. Sodium Cyanide. 2 oz. Sulphuric Acid. 4 oz. Water.

For each 100 cu. ft. space:

For fumigating dormant nursery stock or buildings, place the acid and water in an earthen jar in the house, drop in the cyanide and close the house at once for half an hour. Ventilate for ten minutes before entering. In greenhouse use 1 oz. of cyanide for each 1000 cu. ft. of space; avoid sunlight; excessive moisture; driving winds. Fumigate, between 52° and 70°F.

## FORMULAS FOR COMMON FUNGICIDES.

### LIQUID LIME-SULPHUR.

*Winter Spray.*

1 part Lime and Sulphur. 9 parts Water.

*Summer Spray.*

1  $\frac{1}{4}$  to 1  $\frac{1}{2}$  parts Lime and Sulphur. 45 to 50 parts Water.

Use winter spray for San José scale and peach leaf curl; summer spray for fungi, to which, as needed, add lead arsenate to kill chewing insects.

### DRY LIME-SULPHUR.

There are now on the market several forms of lime-sulphur or similar fungicides, such as B. T. S., that because of convenience in shipping and handling are replacing somewhat the more bulky liquid fungicides. Where experience has shown that spray injury does not result from their use, they may well be substituted for the latter. Use according to directions given by the manufacturers.

### SELF-BOILED LIME-SULPHUR.

8 lbs. Fresh Whitewash Lime.

8 lbs. Fine Sulphur. 45 to 50 gals. Water.

Start the lime slaking, sift and thoroughly stir in the sulphur, using just enough water to prevent burning and allow to boil from heat of lime for fifteen minutes. Then dilute and apply.

A very excellent substitute for this fungicide is the commercial article called "Atomic Sulphur," especially on peaches where it should be used without lead arsenate at the rate of 8 lbs. to 50 gallons water.

### SULPHUR DUST.

Dusting with special grades of very fine sulphur, about 90 parts thoroughly mixed with 10 parts lead arsenate for apples and 80 parts sulphur and 20 parts air-slaked lime for peaches, or with special material prepared by manufacturers, has attained some prominence as a combined fungicidal and insecticidal treatment for fruit trees. Experience so far in this state seems to show that such treatment is much more effective in controlling insects than fungus troubles of the apple. Good results in controlling peach scab and fair results for brown rot are claimed by some authorities. Dusting is much quicker and so cheaper as regards labor, but the cost of material used is considerably greater.

### BORDEAUX MIXTURE.

4 lbs. Copper Sulphate.

4 lbs. Fresh Lime. 40 to 50 gals. Water.

Dissolve the copper sulphate in hot water or from a coarse bag suspended in cold water; slake the lime separately and strain. Dilute the latter to about 20 gals., into which pour the copper sulphate, diluted to about 20 gals., stirring the mixture; dilute further to form the forty-five or fifty gallons; or dilute each to 25 gals., and pour together into barrel.

Stock solutions of the copper sulphate and lime, rate 1 lb. to 1 gal. water, can be made separately and used as needed. In this case four gallons of the stock lime is strained into the spray barrel while half filling it with water and then the four gallons of copper sulphate solution are gradually poured in as the barrel is filled to 50 gallons.

### FORMALIN.

A. 1 pt. (1 lb.) formalin in 50 gals. water, for sprinkling grain to kill smut. See Smut under Oats.

B. 1 pt. undiluted formalin is *sprayed* directly on 50 bushels of grain as it is shoveled over and then heaped in a pile and covered for four hours.

C. 1 pt. formalin in 30 gals. water; soak uncut tubers 1 hour to prevent potato scab.

D. 1 pt. formalin in 12  $\frac{1}{2}$  gals. water, for soil treatment. Use two-thirds to 1 gal. for each square foot of surface treated; cover for 24 hours after treatment; air afterwards and stir soil; allow 7-10 days before seeding and 10-14 days before transplanting in this soil.

### CORROSIVE SUBLIMATE.

4 oz. Corrosive Sublimate. 30 gallons Water.  
Dissolve the corrosive sublimate at first in a small amount of *hot* water and then dilute. Soak uncut seed potatoes in this for  $\frac{1}{2}$  to 1 hour. After each treatment renew strength by adding 1 oz. of corrosive sublimate and water as needed to retain the 30 gallons. Use in wooden containers and mark *Poison*. Good for both scab and black scurf.

### FORMULAS FOR LESS-USED FUNGICIDES.

#### OTHER BORDEAUX MIXTURES.

Dilute Bordeaux Mixture. Use 1 lb. copper sulphate, 4 of lime, and make as above directed. For second and third sprayings of apples to lessen russetting of the fruit.

Soda Bordeaux Mixture. 4 lbs. copper sulphate,  $1\frac{1}{8}$  to  $1\frac{1}{2}$  lbs. soda lye, 50 gals. water. Use only enough lye to make the solution alkaline to test paper. Used sometimes for late spraying of grapes, etc., where spray sediment is objectionable. Care needed in making to avoid spray injury.

Resin Bordeaux Mixture. Melt 5 lbs. resin with 1 pt. fish oil, cool slightly, add 1 lb. soda lye, stirring. Add 5 gals. water and boil till the mixture will dissolve in cold water. Mix 2 gals. with 48 of Bordeaux mixture. Used sometimes on such glaucous plants as asparagus, cabbage, onions, etc., to make a more adhesive spray.

#### POTASSIUM SULPHIDE.

3 ozs. Potassium Sulphide. 10 gals. Water.  
Used chiefly in greenhouses, or for powdery mildews.

### AMM. SOL. COP. CARBONATE.

5 ozs. Copper Carbonate. 3 pils. Ammonia. 45-50 gals. Water.  
Use *just enough* ammonia (if strong, dilute with several volumes of water) to dissolve the copper carbonate; then dilute to final volume. This fungicide is not as good as Bordeaux, but is used to avoid sediment on the foliage or fruit.

### COPPER SULPHATE.

2 to 3 lbs. Copper Sulphate. 45-50 gals. Water.  
Used chiefly as a winter spray. 1 lb. to 250 gals. water is sometimes though rarely used on foliage.

### COPPER LIME-SULPHUR.

2 lbs. Copper Sulphate.  $1\frac{1}{2}$  gals. liquid Lime-Sulphur. 45-50 gals. Water.  
Dissolve copper sulphate in part of the water, and then add with the lime-sulphur to the remainder. Apparently a good fungicide but likely to russet apples as does strong Bordeaux.

### FORMALIN FUMES.

3 pts. Formalin. 23 ozs. Potassium Permanganate.  
For each 1000 cu. ft. Space.

Place bulbs or tubers in 6 to 12 in. crates so fumes can get at them. To prevent injury to potatoes, fill space at rate of 167 bu. Place formalin in large pail in cleared central space and drop in the crystals of potassium permanganate. Close room air-tight for 24 to 48 hours.



## INSECT AND FUNGIOUS PESTS OF CULTIVATED PLANTS.

### APPLE.

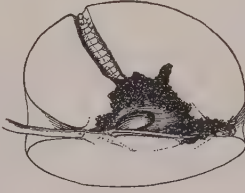
*Insects, etc.*

**Bud-Moths:** **Case Bearers:** **Leaf Crumpler:**—Small overwintering caterpillars feed upon the unfolding leaves. Spray with lead arsenate as soon as leaf buds begin to open. Repeat a few days later, if necessary. Rept. 1909, p. 353.

**Canker-Worms:**—During May small looping caterpillars devour the leaves and spin down on threads when disturbed. Spray foliage with lead arsenate before blossoms open, and again soon after they fall. In unsprayed orchards sticky tanglefoot bands should be placed around trunks of trees in October, kept sticky until January 1st, and again kept sticky during April and May. Rept. 1908, p. 777.

**Tent-Caterpillar:**—During May the caterpillars form nests at the forks of the branches, and devour the leaves. Clip off and burn egg masses on twigs in winter. Remove nests with caterpillar brush. Spray with lead arsenate once before the blossoms open and again soon after they fall. Bull. 177, and Rept. 1913, p. 226.

**Lesser Apple Worm:**—Larva feeds on exterior of nearly mature fruit, and often causes



injury in storage. Spray twice as for codling-moth. Keep foliage and fruit covered until fruit is nearly grown. Rept. 1910, p. 595.

**Codling-Moth** or **Apple-Worm:**—Pink caterpillar tunnels inside the fruit, especially around the core. Spray with lead arsenate as soon as the blossoms fall. Repeat three and six weeks later. Rept. 1910, p. 594.

**Brown-Tail Moth:** **Fall Web-Worm:**—See Pear.



**Gipsy Moth:**—Occurs in the United States only in south-eastern New England, New York and New Jersey. Brownish hairy caterpillars defoliate trees in May and June. Band trees with tanglefoot, and with burlap, which should be examined each day to destroy caterpillars. From August to May egg-masses can be destroyed by soaking them with creosote. Spray foliage with lead arsenate. Bull. 186; Repts. 1905, p. 246; 1906, p. 235; 1907, p. 300; also placard.

**Curculios:**—Grubs of both apple and plum curculios infest the fruit, making it gnarled and ill-shaped. Spray twice after blossoms fall as for codling-moth, and remove infested fruit in thinning. Keep fence rows clear of trash. Rept. 1904, p. 219.



**Green Fruit Worms: Palmer Worm: Leaf Roller**—Caterpillars all feed upon foliage and immature fruit. Spray with lead arsenate, as for codling-moth.

**Tussock Moths**—Tufted caterpillars of several species feed upon the leaves in mid-summer. Spray with lead arsenate as for codling-moth. Rept. 1905, p. 230; 1907, p. 332; 1916, p. 105; 1917, p. 325.

**Yellow-necked Caterpillar: Red-humped Caterpillar**—Feed in clusters and often strip young trees in fall. Hand-picking is easy method of control. Spray leaves with lead arsenate. Rept. 1901, p. 274; 1917, pp. 328, 329.

**Maggot or Railroad Worm**—Maggots tunnel through the pulp of the ripening fruit of sweet and sub-acid varieties, especially those ripening early in the season. Destroy all infested fruit. Adult flies may be killed by late sprays of lead arsenate. Rept. 1910, p. 593.



**Round-Headed Borer: Flat-Headed Borer**—Grubs burrow in wood at base of trunks. Watch trees and dig out borers wherever sawdust appears. Paint trunk with lead arsenate and lime-sulphur. Rept. 1907, p. 333.

**Leaf Hoppers**—Whitish insects sucking sap from underside the leaves. Spray with nicotine solution, as for aphids.

**Tarnished Plant Bug**—Injures developing fruit by sucking sap, forming dimples. Spray with nicotine solution as for aphids.

**Red Spider: Clover Mite: European Red Mite**—Cause much injury to leaves, especially in dry seasons. Overwintering eggs killed by winter spray of lime-sulphur.

**Leaf-Blister Mite**—See Pear.



**Green and Rosy Aphids**—Green aphids suck sap from the leaves and terminal shoots, causing leaves to curl and checking growth. Rosy aphids infest fruit clusters, checking development. Use delayed dormant spray with nicotine solution ( $\frac{1}{2}$  pint in 50 gallons water), either separately or in combination with lead arsenate, lime-sulphur or Bordeaux mixture. Repts. 1903, p. 259; 1909, p. 343.

**San José Scale**—See Peach. Spray dormant trees with lime-sulphur or miscible oil. Bull. 165; Rept. 1904, p. 221.

**Red Bugs**—Two species of red leaf bugs suck the sap, causing leaves and fruit to become distorted. Spray with nicotine solution, as for aphids throwing the spray against the tree from opposite directions at the same time. Rept. 1917, pls. II-III.

**Woolly Apple Aphid**—A bluish-white, cottony plant louse in colonies on bark, forming galls or swellings on twigs of small trees, and preventing wounds from healing; also on roots, forming galls, and destroying small feeding roots. Plant only clean or fumigated stock. Soak soil with carbon disulphide,  $\frac{1}{2}$  ounce in 4 gals. water. Spray above ground with kerosene emulsion.

**Oyster-Shell Scale: Scurfy Scale**—Scale insects with elongated or pear-shaped shells, on bark, suck sap from the twigs; the former about the same color

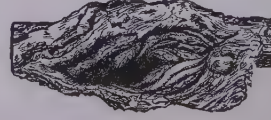


as the bark, the latter light gray or whitish. Spray with nicotine solution; soap and water; or kerosene emulsion, about the second week in June. Bull. 143; Rept. 1903, p. 225.

*Fungus, etc.*



**Baldwin Spot**—Shows as small diseased masses of brownish tissue, usually a short distance beneath the skin; finally may appear at the surface as small, discolored, shrunken areas, then very similar in appearance to some of the fruit speck troubles. Not a fungous, but apparently a physiological disease. Thought by some to be due to unusual local loss of water; similar troubles may start from punctures of rosy aphid or other puncturing insects. No remedy known, except possibly irrigation in the west.



**Cankers**—Occur on branches and are caused chiefly by European canker fungus which eventually forms a cavity surrounded by concentric elevated rings of wood extending to bark, which each year is killed a little further, adding another ridge. Cut off infected branches, or cut out infected wood and bark; paint over cut surfaces. Keep orchard well sprayed and trimmed. Rept. 1903, p. 299.

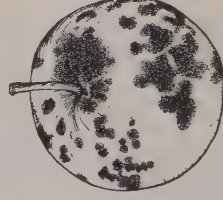
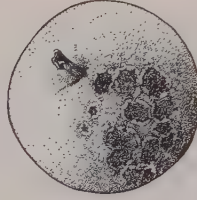
**Black Rot**—Causes mature fruit to rot, eventually turning it black; forms small brown spots on leaves; does some damage through cankers on branches, which are eventually killed. Treat as for scab; prune and burn all dead limbs and twigs; cut out and paint over large cankers when found. Rept. 1909–10, p. 590.

**Fruit Specks**—Form more or less numerous, small, brown or black spots, starting at surface of fruit and slowly working inward; the Brooks fruit spot often has a pinkish or purplish border in

light-skinned varieties. Usually controlled by spraying as for scab. Late spraying is important. Rept. 1909–10, p. 590.

**Rust**—Shows as orange-colored blotches on leaves, eventually producing minute fringed clustered-cups imbedded on the under side; less frequent on fruit. Rust spreads to the apple from the cedar-apples, which appear in the early spring on the red cedar. All cedars near the orchard should be destroyed. There is great difference in the susceptibility of different varieties to this disease. Spraying is only partially successful in this state, as the leaves must be well coated continuously with spray from the time they begin to unfold, until the end of July. Repts. 1891, p. 161; 1909–10, p. 591.

**Scab**—Produces “scabby spots” on fruit and leaves; rarely on twigs. Spray the unfolding leaves before the blossoms open, again after the petals fall, and follow with a third spraying about four weeks later. For first treatment, use strong Bordeaux, for second and third, weak Bordeaux or lime-sulphur or the latter for all three treatments. Very susceptible varieties sometimes need four treatments, the last two at intervals of about two weeks. Rept. 1909–10, p. 591.



**Sooty Blotch**—Forms on fruit an olive-black superficial growth in distinct round colonies, or often merging together. Spray with Bordeaux as for scab, or with lime-sulphur  $\frac{1}{2}$  to 50. The sprayings after blossoming are the more important. Rept. 1909–10, p. 592; 1911, p. 367.

**Blight**—See Pear.





**Spray Injury**—Takes the form usually of burn on leaves and russetting on fruit. Is most likely to occur after second and later sprayings. Worst in wet seasons. Spraying in bright sunshine may cause some scorch of fruit on sunny side. Varies greatly with different sprays. Avoid those known to be injurious or injurious combinations (as soap and lead arsenate); use Bordeaux only for *first* summer treatment or on varieties not especially subject to russetting. Rept. 1911, p. 360.

**Winter Injury**—Takes various forms from different conditions, such as imperfect fertilization or russetting of fruit following late spring frosts; sun scorch of trunks due to mild winter weather followed by sudden cold; bud and twig killing, frost cracks in trunks, blackened woods, dead roots, etc., following unusually cold winters or unfavorable environment. Set out only hardy varieties; avoid planting in wet ground or on hill-sides with extreme south or southwest slopes. Head trees low; avoid late fertilization and cultivation; keep earth tight around trunks; use cover crops. Rept. 1903, p. 303; 1906, p. 310; 1914, p. 6.

**Storage Rots**—Are troubles caused by a variety of fungi. Store fruit, in a dry condition, in a cool, well-aired place. Do not store in too deep piles or too tight receptacles. Use poorer keeping varieties first, and sort over if necessary. Apples from well sprayed trees keep best. Rept. 1915, p. 426.

#### *General Treatment for Apple Orchards.*

For the general control of fungi and insects on apples in Connecticut we make the following recommendations:

(1) Winter treatment (spraying dormant trees) is necessary only in the case of the presence of the San José scale, or leaf-blister mite, when commercial lime-sulphur, 1-9, or miscible oils, 1-15, may be used.

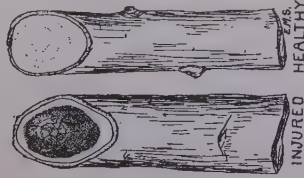
(2) As a rule, three summer treatments with a fungicide are necessary to control fungous diseases, and the last two of these should contain an insecticide. These sprayings should be made as follows: 1st, just before the blossoms open, on the young unfolding leaves (April 27th to May 10th, according to the season and variety); 2nd, as soon as all the blossoms have fallen (May 10th to 30th); 3d, about one month later (usually June 10th to 25th).

(3) Where fungi are not prevalent, especially scab, the first summer treatment may be omitted. Occasionally, perhaps in alternative years, where fungi are quite inconspicuous, the fungicide may be entirely omitted, and only the two sprayings with lead arsenate for insects given. With certain fungi and insects a fourth summer spraying is desirable.

(4) For fungicides, we recommend Bordeaux mixture of the 4-4-50 strength for the first spraying, and of the 1-4-50 strength or lime-sulphur for the later sprayings; or lime-sulphur, used at a strength of  $1\frac{1}{4}$  to  $1\frac{1}{2}$  gallons per fifty gallons of water, for all three sprayings. The former has better fungicidal value, and the latter is less likely to produce spray injury, especially russetting of the fruit. Where fungi are prevalent, the former might be used, while with varieties russetting badly, as Baldwin, the latter is likely to prove more satisfactory in the second and third summer treatments.

(5) For the insecticide in the above, use lead arsenate, if in the paste form at the rate of three pounds per fifty gallons of the mixture, or if in the powder form one and one-half pounds per fifty gallons.

(6) If canker worms, tent-caterpillar, bud-moth, or brown-tail moth are causing damage, add lead arsenate to the first





summer treatment, and if aphids are present nicotine solution should also be included. Nicotine solution may be added to any of the subsequent treatments to destroy aphids, red bugs, tarnished plant bug, etc.

*Insects.*

**Oyster-Shell Scale**—See Apple.

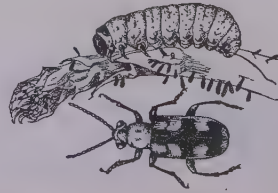
## ASH

*Insects.*

### ASPARAGUS.

**Asparagus Beetles, Common and 12-spotted**

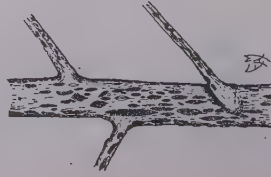
—Adults and larvae devour the foliage. Cut everything clean during the cutting season; afterward spray with lead arsenate. Repts. 1902, p. 172; and 1903, p. 276.



**Asparagus Miner**—Larvae tunnel under epidermis of stem near base, causing premature death of plant above ground. Burn infested stalks. Rept. 1906, p. 303.

**Rust**—Produces (most conspicuous stages) small reddish or black elongated pustules scattered over stems. In fall, carefully gather and burn all stems from affected beds and escaped plants in vicinity. In gathering for market cut below the ground, as protruding stems offer opportunity for development of first stage of the fungus. Spraying with resin Bordeaux partially controls the disease, but this is difficult and expensive. Begin spraying the latter part of July and repeat about every 10 days until the middle of September. Thorough cultivation and fertilization, with plenty of humus in the soil, are advocated as beneficial. Grow varieties most resistant to the disease or select seed for

*Fungi.*



new stock from resistant individuals if found. This disease is not so serious as it was some years ago. Repts. 1896, p. 281; 1904, p. 313.

*Insects.*

## ASTER.

**Blister Beetles**—Three or four species feed upon the flowers, the black one being commonest. Practice hand-picking and cover choice plants with mosquito netting. Bull. 208, p. 110.

*Fungi, etc.*

**Yellows**—Shows in the yellowed and often imperfectly developed foliage and one-sided blossoms. A physiological trouble whose cause is not definitely known. Buy best seed; transplant only healthy plants, and have soil conditions good. Repts. 1903, p. 306; 1914, p. 413 (26).



## BARLEY.

*Insects.*

**Army Worm**—See Grass.

*Fungi.*

**Rusts**—See Oats and Wheat.

**Smuts**—Are of two kinds, covered and loose, both largely destroying the infected spikes and changing them into black, sooty structures, in the latter kind easily dissipated. Treatment, see Oats and Wheat. Rept. 1903, p. 306.

## BEAN.

### Insects.

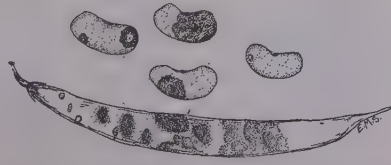
**Green Clover Worm**—Occasionally green, wriggling caterpillars riddle the leaves in June and July. Dust string beans with air-slaked lime or other fine powder. Spray shell beans with lead arsenate. Repts. 1908, p. 828; 1919, p. 165.

**Weevils**—Adults lay eggs in the pods in the field and continue to breed in the dried seed, finally rendering it unfit for food or for planting. Fumigate the seed with carbon disulphide, store in air slaked lime, or heat in oven for 1 hour between 120° and 150° F. Bull. 195, p. 6.



### Fungi.

**Anthrachnose**—Shows on leaves and pods as roundish discolored areas, often with a purplish border. Save seed from pods showing no spots and plant these by themselves, selecting each year seed from unspotted pods for the seed crop and using remainder for general crop. Destroy all infected seedlings. Where very troublesome spray with Bordeaux, beginning when plants are only a few inches high and repeating about every 10 to 14 days until pods are forming. Rotation and destruction of old vines may prove helpful in keeping the trouble in check.



**Blight**—Appears much like anthracnose, but with discolored areas usually having more of a translucent or watery character. Treat same as anthracnose. Repts. 1898, p. 262; 1903, p. 307.

**Downy Mildew**—Forms dense, white, woolly growths on pods and less luxuriantly on young stems and leaves of the Lima bean. As the fungus usually appears first and most vigorously in low moist places, the land used should be high or well drained. Serious only in years unusually moist after the middle of July. Spray with Bordeaux beginning about the middle of July, and repeat every 10-14 days until the middle of September. Rept. 1905, p. 278.

**Rust**—Produces small, round, reddish or black, dusty outbreaks, usually on the leaves. Plant varieties not likely to rust. Burn the old infected plants in the fall. Rept. 1903, p. 308.

### Insects.

#### BEET-CHARD.

**Leaf-Miner**—A small fly lays eggs in the leaves, and the larvae tunnel or mine between upper and lower surfaces. Practice clean cultivation. Destroy all infested leaves. Destroy all plants of the weed known as "lambs quarters" in which this insect breeds. Practice late fall plowing.

### Fungi.

**Leaf Blight**—See Mangel. Rept. 1903, p. 309.

## BEGONIA.

### Eelworms.

**Leaf-Blight Eelworm**—Produces conspicuous dead areas on the leaves of Begonias (especially var. *Cincinnati*), ferns, etc. Spots vary in size and shape according to host and disposition of larger veins.



Buy healthy stock only; keep infected plants by themselves and give them plenty of room; keep leaves as dry as possible and pick off and burn worst infected. Rept. 1915, p. 455.

## BIRCH

*Insects.*

**Tussock Moths**—See Apple, Hickory, and Horse Chestnut.

**Birch Leaf-Skeletonizer** or **Birch Bucculatrix**—Small greenish-yellow larvae feed upon both sides of the leaves in late summer, often entirely defoliating the trees. Spray with lead arsenate in July. Rept. 1910, p. 701.

**Bronze Birch Borer**—Grub makes spiral tunnel just beneath bark of upper main branches, ridges showing on outside. Cut and burn infested trees before May 1st.

## BLACKBERRY.

*Insects.*

**Blackberry Crown Borer**—Larva tunnels in roots and at base of stem. Dig out and destroy.

**Red-Necked Cane Borer**—Larva tunnels in canes causing an irregular swelling or gall, often three inches in length. Cut and burn all infested canes in winter or early spring.

**Blackberry Sawfly**—Larvae devour leaves in June and first part of July. Spray with lead arsenate when young larvae appear. Rept. 1912, p. 236.

*Fungi, etc.*

**Crown Gall**—Forms hard galls or irregular excrescences on roots and lower parts of stems of blackberries, raspberries and several other hosts. Dig out and burn affected plants as soon as discovered. Never use infected stock for transplanting. A bacterial trouble. Rept. 1903, p. 354.

**Leaf Spot**—Forms on leaves small circular spots with whitish center and purplish border; also occurs on dewberry and raspberry. Not usually serious but where necessary it probably can be controlled by Bordeaux applied to the leaves, beginning before they have reached their full size. Rept. 1903, p. 309.

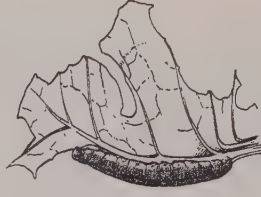


**Orange Rust**—Breaks out in spring or early summer as dusty masses of bright orange spores over the under side of the leaves. The fungus is perennial in the underground parts of the host, so that the disease appears year after year. Dig up and burn infested plants. Rept. 1903, p. 309.

## BOX.

*Insects.*

**Leaf-Miner**—A small two-winged fly lays eggs in the leaf and the larvae tunnel between the upper and lower surfaces. Destroy infested leaves.



**Oyster-Shell Scale**—See Apple.

## CABBAGE-CAULIFLOWER.

*Insects.*

**Cabbage Worm**—Green worms feed upon leaves all through season. Spray unheaded plants with lead arsenate. Use insect powder or hellebore on headed plants. Bull. 190, p. 9; Rept. 1903, p. 271.



**Cabbage Looper**—Smooth looping caterpillars feed with cabbage worms late in





summer, and require same treatment. Bull. 190, p. 12; Rept. 1910, p. 706.

**Cabbage Maggot**—Infests stems of early-set plants near surface of ground checking growth and often killing them. Practice crop rotation. Place hexagonal tarred paper disks around stems at setting time. Treat with carbolic acid emulsion. Bull. 190, p. 3; Repts. 1908, p. 832; 1914, p. 142; 1915, p. 114.

**Cabbage Aphis**—Sucks sap from the leaves. Spray with nicotine solution and soap or with kerosene emulsion. Bull. 190, p. 14.

*Fungi, etc.*

**Black (Bacterial) Rot**—Forms black lines in veins of leaves. In time leaves turn yellow and easily drop off, and interior of head develops a general soft rot. As the germs can be carried on the seed, avoid seed from infected fields. If in doubt, treat seed in formalin, 1 part to 240 of water for 15 minutes. Keep refuse from diseased plants out of manure; practice rotation; make seed bed in new soil if disease appears in old one. Rept. 1912, p. 345.

**Club Root**—Causes knob-like enlargements on the roots of cabbage and allied plants. The germ often becomes established in the soil; when possible avoid such land and the use of refuse from old plants on the soil. Be especially careful that the seed bed is not infected. Infected land, if used, should be treated in the fall with lime broadcast at the rate of 80 bushels per acre and worked in. Rept. 1903, p. 310.



**Soft Rot**—See Salsify. Report 1903, p. 311.

## CARNATION.

*Insects.*

**Green Fly or Aphis**—Sucks sap from young leaves and buds. Fumigate greenhouse with tobacco, or spray with nicotine solution and soap, or with soap and water.

*Fungi.*

**Leaf Mold and Leaf Spot**—Are two troubles much alike in appearance, producing grayish spots with colored borders on stem, leaves and calyx. Treat as for Rust.

**Rust**—Produces small dusty pustules, more or less confluent, on the leaves and stems. Select, if feasible, only rust-resisting varieties. Spray in field with Bordeaux, adding  $1\frac{1}{2}$  lbs. soap to each 50 gallons (helps mixture to adhere to plants). Select for transplanting only hardy and rust-free specimens. Keep air of greenhouse as dry as is consistent with good growth. One or two sprayings with Soap- or Resin-Bordeaux, after transplanting in greenhouse, may be given if desired; for repeated sprayings use potassium sulphide or weak copper sulphate. Rept. 1903, p. 312.

**Stem Rot and Wilt**—Cause the lower leaves first to turn yellow and dry up; then as the stem gradually rots off at its base, the whole plant becomes affected and finally dies. Select cuttings only from perfectly healthy plants, and if necessary start these in sterilized soil and replant out of doors in new land, avoiding excessive use of manure. If disease appears after setting out in the greenhouse, pull up infected plants upon appearance of first symptoms, make liberal application of lime, avoid over-watering, and see that roots are properly aerated. Repts. 1897, p. 175; 1903, p. 312.



## CEDAR.

*Insects.*

**Web-Worm**—Small brown caterpillars feed upon the leaves which they web together. Spray with lead arsenate.

*Fungi.*

**Cedar-Apple Rust**—Appears in spring as conspicuous rounded galls with jelly-like horns bearing spores that carry the fungus to apple and related hosts. Cut off and burn all *cedar-apples* if undesirable to destroy the trees. See Apple Rust.

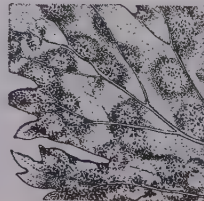
## CELERY.

*Insects.*

**Celery Caterpillar**—Feeds upon the leaves of celery, parsley, fennel, carrot and parsnip. On the latter two plants lead arsenate may be used. On celery and parsley hand picking is perhaps the best remedy.

*Fungi.*

**Leaf Blight and Leaf Spot**—Are two diseases showing "rusty" spots on leaves and petioles; the latter trouble distinguished by the very minute black dots in the discolored spots (fig.), often progressing in stalks after storage. Spray the plants thoroughly in the seed bed with Bordeaux, as infected plants are often the means of introducing the trouble in the field. If necessary, continue the spraying after transplanting at intervals of about two weeks up to the middle of September. Before covering for bleaching, if leaf spot is abundant, dust with sulphur, and before final storage remove infected leaves and dust again. Rept. 1897, p. 167.



**Soft (Heart) Rot**—Shows as a soft rot of the tissues often confined to the heart. Do not plant in too wet soil, avoid land with green cover crops recently plowed in; in banking allow for proper aeration. See Salsify. Rept. 1914, p. 10.

## CHERRY.

*Insects.*

**Cherry or Pear Slug**—Larvae eat away the green tissue from upper side of leaf. Spray or dust with lead arsenate and sulphur.

**Canker Worms**—See Apple.

**Cherry Maggots or Fruit Flies**—Larvae of two species infest maturing fruit. Sprinkle foliage with sweetened lead arsenate in early June to kill the adult flies.

**Plum Curculio**—See Plum..

**Cherry Aphid**—A brown aphid which sucks sap from under side of leaves causing them to curl. Spray with nicotine solution and soap, soap and water, or kerosene emulsion.

*Fungi.*

**Black Knot**—Forms knot-like excrescences, usually several inches long, on twigs and branches. When planting, use only trees free from this trouble; in the orchard, cut off and burn all infected branches in late fall or winter, painting over large cut surfaces. Cutting out knots is rarely advisable, as new outbreaks usually result. In cutting off, cut several inches below the knot, to insure removal of the mycelial threads in the tissues. Remove all knots each year until they fail to reappear. Spraying in spring and early summer with self-boiled lime-sulphur or atomic sulphur helps to keep



new knots from fruiting, but is entirely secondary in importance to the removal of the knots. Rept. 1911, p. 399.

**Brown Rot**—See Plum. Rept. 1911, p. 402.

**Leaf Spot**—Shows as numerous, closely placed, purplish spots on leaves, which often have "shotholes." Spraying, if begun on young leaves early in May, is effective but use the dilute Bordeaux, or better still, self-boiled lime-sulphur or atomic sulphur to avoid injury to the foliage. Give several sprayings at intervals of two weeks. This helps to keep down the brown rot also. Repts. 1895, p. 188; 1911, p. 401. Also known as anthracnose.

**Powdery Mildew**—Develops a cobweb-like growth over the leaves; in fall forms numerous, minute, black, fruiting-bodies, especially on under surfaces. Usually worst in young trees; controlled by spraying if necessary.

*Insects.*

#### CHESTNUT-CHINQUAPIN.

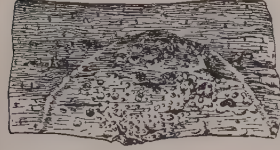
**Canker Worms**—See Apple.

**Nut Weevils**—Long-nosed snout beetles lay eggs in developing fruit and the grubs infest the nuts. Destroy all infested nuts. Fumigate nuts with carbon disulphide as for beans.

**Two-lined Chestnut Borer**—Long, slender, flat-headed larvae make sinuous tunnels under bark of weakened chestnut and oak trees. Badly infested trees should be removed and burned, or the bark removed before the insects mature and spread to other trees.

*Fungi.*

**Bark Disease (Blight)**—Forms cankers in the bark that eventually girdle infected limb and cause death of parts above. Spreads over tree so that usually it dies within two to five years.



Rarely shade trees can be saved by carefully cutting out and painting over the cankers. For forest trees it is best to let the disease take its course, and remove at least the larger trees within a year or two after their death to prevent deterioration of the wood. Most of the chestnuts in the state have been already killed. Rept. 1912, p. 359; Bull. 178.

#### CHRYSAANTHEMUM.

*Insects.*

**Black Fly or Aphis**—Sucks the juice from the young leaves and flower stems. Fumigate the house with tobacco; dip the plants in or spray them with soap and water or nicotine solution and soap.

**Gall Midge**—Larvae form cone-shaped galls on leaves and new shoots. Spray plants about three times each week with nicotine solution and soap. Rept. 1919, p. 161.

*Fungi.*

**Powdery Mildew**—Develops a white mealy or cobweb coating on leaves. Use good judgment in airing and watering, and if necessary, spray from time to time with potassium sulphide or paint heating pipes with sulphur.

**Rust**—Appears as dusty reddish-brown outbreaks, about the size of a pin head, chiefly on under sides of leaves. Avoid worst rusting varieties. Start with cuttings free from rust. Destroy rusted leaves, especially on cuttings. Early sprayings with dilute copper sulphate, potassium sulphide, etc., may help to prevent the trouble from getting a start. Rept. 1903, p. 315.



## CINERARIA.

*Insects.*

**Aphis or Green Fly**—Sucks sap from the leaves and stems. Use nicotine solution and soap, or soap and water, as a spray or dip.

## CORN.

*Insects.*

**Cut Worms**—See Tomato.

**Army Worm**—See Grass.

**Stalk Borer**—See Dahlia.

**White Grubs**—See Grass.

**Corn Ear Worm**—Eats the immature kernels at the end of the ear. Dust the silk with equal parts sulphur and powdered lead arsenate. Rept. 1919, p. 188.

**European Corn Borer**—Imported into eastern Massachusetts, New York and Canada. Larvae tunnel in all parts of plant above ground. Destroy all infested plants. Rept. 1918, p. 316.

*Fungi.*

**Leaf Blight**—Kills parts of the leaves in August and September much like an early frost. Most injurious in wet late seasons. Plant early maturing varieties and stimulate growth by good fertilization and cultivation. Rept. 1903, p. 317.

**Root and Ear Rots**—Injures roots and base of stalk with a reddish-brown rot. Stalks are easily broken off and often fail to produce good ears, the worst infected showing a moldy, white or pinkish growth. Plant only vigorous, disease-free seed, practice yearly rotation and do not let corn follow other grains. Bull. 222, p. 427.



**Smut**—Forms black dusty outbreaks that appear on various parts of the plant. It is especially injurious to certain varieties of sweet corn. Avoid the use of fresh manure on the land. Seed treatment is ineffective. The removal and destruction of spore masses is recommended by some writers.

## CRANBERRY.

*Insects.*

**Fireworm or Black-headed Cranberry Worm**—Small, pale green, black-headed caterpillars web the leaves and new shoots together and feed inside the nest. Spray with lead arsenate to kill the caterpillars. Flood the bog for three days to kill the pupae.

**Yellow-headed Cranberry Worm**—Small, green yellow-headed caterpillars injure plants in same manner as the preceding. Spray with lead arsenate. Keep bogs flooded until about May 20.

**Cranberry Fruit Worm**—Pale green larvae infest the berries. Flood the bog for about two weeks as soon as the fruit has been harvested. Destroy all infested berries.

## CUCUMBERS.

*Insects.*

**Striped Cucumber Beetle**—Attacks young plants, eating the leaves. Larvae infest the main root or stem under ground, often killing the plant. Dust leaves with dry lead arsenate. Cover plants with screens. Bull. 216, p. 34; Rept. 1908, p. 807.



**Melon Aphid**—See Melon.



*Fungi, etc.*

**Anthracnose**—Produces prominent discolored spots, more or less merged, on leaves; occurs occasionally on fruit. Treatment is the same as for mildew. See Watermelon.

**Downy Mildew**—Forms discolored spots as in preceding, but beneath shows a minute thin growth of upright threads bearing dark colored spores. Repeated sprayings with Bordeaux about every 10 to 14 days during the season, beginning at least by middle of July, usually keeps this disease in check. The same fungus occurs on Melons. Rept. 1904, p. 329.

**Mosaic and White Pickle**—Are two very similar, if not identical, physiological diseases, showing in the former on the leaves as mottling of lighter or yellow-green areas scattered among the normally green tissues, and in the latter causing the fruit to become irregularly shaped, knobbed, and often mottled or whitish in color. Keep down sucking insects that may spread the disease, as it is infectious; pull up and destroy vines first showing it. Rept. 1915, p. 430.

**Wilt**—See Squash.

**CURRENT.**

*Insects.*

**Current Fruit Fly**—Small maggots infest the berries, which color prematurely and drop. Destroy infested fruit.

**Current Worm**—Devours foliage in May. Spray with hellebore or lead arsenate. Rept. 1902, p. 170.

**Current Borers**—The larvae of two species



of insects tunnel in the pith of the stems, causing the leaves to droop and wilt. Destroy infested canes during May.

**Current Stem Girdler**—Adults cut or girdle tip of new shoots after laying eggs in them. Cut and burn these tips at any time of year. Rept. 1896, p. 238.

**Current Aphids**—Yellowish-green aphids on under side of leaves causing them to curl. Underspray with nicotine solution or kerosene emulsion.

**Four-Lined Leaf-Bug**—A yellow and black striped bug sucking sap from the leaves. Spray with nicotine solution and soap. Bull. 208, p. 118.

**San José Scale**—See Peach.

**Scurfy Scale**—A conspicuous pear-shaped light-gray scale on bark, the insect sucking sap from twigs. Spray about second week in June with kerosene emulsion or nicotine solution and soap. Bull. 143; Rept. 1903, p. 227.

*Fungi.*



**Anthracnose and Leaf Spots**—Cause spots on the leaves and usually their premature shedding; the former also spots the fruit of certain varieties. Spray with Bordeaux as the leaves unfold, and repeat at intervals of 10 to 14 days until fruit begins to turn. If necessary continue spraying after harvest. Rake up and burn leaves in fall.

**Blister Rust**—Shows first as dusty orange-colored outbreaks about size of pinhead on lower surface of leaves, and later as short hair-like growths. Worst on black currants. Alternate host is white pine. Report presence to the Experiment Station. Rept. 1911-12, p. 347. See Pine.



## CYCLAMEN.

*Insects.*

**Leaf-Mite**—Transparent microscopic mites cause leaves to curl, and plants do not blossom. Syringe under leaf surface strongly with water. Spray with, or dip plants in nicotine solution and soap, 1 part in 400 parts of water. Avoid excessive moisture in house. Rept. 1914, p. 176.

## DAHLIA.

*Insects.*

**Tarnished Plant Bug**—Sucks the sap from the stems and buds causing them to fall. Spray with nicotine solution and soap. Rept. 1904, p. 218.

**Stalk Borer**—Larva tunnels up and down inside the main stem, the top portion usually wilting and dying. Carefully make longitudinal slit in the stem and kill the borer. Bull. 208, p. 111; Rept. 1919, p. 180.

## EGG-PLANT.

*Insects.*

**Flea Beetle**—See Potato.

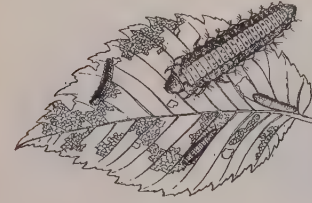
**Colorado Potato Beetle**—See Potato.

*Fungi.*

**Fruit Rots**—Caused by several fungi, the gray mold producing the most extensive rot. Spray with Bordeaux; pick off and carry away the rotting fruit.

*Insects.*

**Spiny Elm Caterpillar**—Clusters of black spiny caterpillars often strip certain branches of elm, willow, and poplar. Remove and destroy entire cluster, or spray with lead arsenate. Rept. 1906, p. 260.



**Elm Leaf Beetle**—Adult beetles eat holes through the leaves in May, and in June and July the larvae or grubs eat away the green tissues from the under surface. Spray with lead arsenate early in May to kill egg-laying beetles, or spray under surface of leaves with same mixture about June 1st, to kill the larvae. Yellow pupae at base of trees may be killed with kerosene emulsion or soap and water. Bull. 155; Rept. 1908, p. 815.

**Canker Worms**—See Apple.

**White-Marked Tussock Moth**—See Horse Chestnut.

**Leopard Moth**—Larvae tunnel in branches under the bark, cutting deep galleries, often girdling the branch, which later breaks off and falls to the ground. Small trees may be examined and borers killed by injecting carbon disulphide, or by inserting a wire. Bull. 169; Rept. 1911, p. 317.

**Elm Scale**—A large brown soft scale, oval in shape with cottony marginal fringe, located especially in the cracks of the bark of trunk and lower branches, sucking the sap. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 235.

**White Elm Scale**—A whitish pear-shaped scale on twigs. Spray about June 10th with kerosene emulsion.

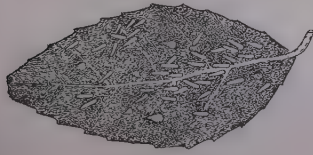
**Elm Woolly Aphids**—Several species curl the leaves, or form in cottony masses on the bark. Spray with kerosene emulsion. *Fungi.*

**Leaf Spot**—Shows as black slightly elevated specks more or less thickly imbedded in the leaves and causing their premature fall. Not usually so injurious as to merit the expense of spraying with Bordeaux, which should start on the immature leaves. Rept. 1909-10, p. 717.

## EUONYMUS.

### *Insects.*

**Euonymus Scale**—The various species of Euonymus are attacked and often injured by this scale, which has narrow white (male) or pear-shaped gray or brown (female) shells. Cut and burn infested twigs. Cover and fumigate with hydrocyanic acid gas. Spray with nicotine solution or kerosene emulsion during June to kill young. Bull. 151; Rept. 1905, p. 240.



## FERN.

### *Insects, etc.*

**Woolly Bears**—Several kinds of light brown hairy caterpillars devour the fronds in late summer. Spray with lead arsenate.

**Hemispherical Scale**—Brown, oval convex scales on fronds of plants under glass. Apply soap and water or nicotine solution as a dip or spray. Bull. 151, p. 9; Rept. 1905, p. 239.

**Leaf-Blight Eelworm**—See Begonia.

## GERANIUM.

### *Insects.*

**Greenhouse Leaf-Tyer**—Small green wriggling caterpillars feed upon the leaves of plants under glass. Spray with lead arsenate.

**White Fly**—See Tomato.

**Leaf Mite**—See Cyclamen.

### *Fungi.*

**Gray Mold Rot**—Produces dead spots on leaves and blasts blossoms. Worst in poorly lighted and leaky greenhouses. Keep dripplage off plants; avoid watering in cloudy or muggy weather; ventilate. Attacks as a semi-parasite a variety of greenhouse plants. Rept. 1903, p. 322.

## GOOSEBERRY.

### *Insects.*

**Currant Worm**—Devours foliage. Apply hellebore or lead arsenate early in season. Rept. 1902, p. 170.

**Gooseberry Fruit-Worm**—Feeds inside the berry. Destroy infested berries.

**Currant Fruit Fly**—See Currant.

### *Fungi.*



**Mildew**—Forms a felt-like growth on fruit and leaves of young shoots. Worst on European varieties, also attacks currant, especially young shoots. Spray with potassium sulphide or other sulphur spray as soon as buds break, and repeat about every ten days until the end of June.

**Blister Rust**—Not common as yet on cultivated varieties. See Currant.

## GRAPE.

### *Insects.*

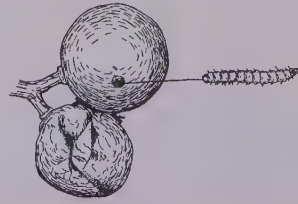
**Grape Vine Flea Beetle**—Adults and larvae devour the leaves. Spray with lead arsenate the latter part of June.

**Rose Chafer**—Long-legged brown beetles appear about June 15th and feed upon leaves, flowers and newly set fruit, often doing great damage. Cover choice plants with netting. Spray heavily with lead arsenate just before blossoms open and if necessary again after fruit has set. Rept. 1916, p. 111.



**Grape Plume Moth**—Small green spiny caterpillars web together the newly formed leaves at the tips of new shoots. Damage more apparent than

real. Crushing by pinching these leaves is the best remedy. Rept. 1914, p. 190.



**Grape Berry Moth**—Larva feeds and develops inside the berries and is the cause of most wormy grapes. Spray with lead arsenate soon after fruit sets, and repeat twice at intervals of about ten days. Bag the clusters soon after the fruit sets.

**Grape Root Worm**—Adult beetles eat chain-like holes in leaves in July, and larvae or grubs devour the small feeding roots and eat channels in the bark of the larger roots and main stem underground, often causing great injury. Spray leaves with lead arsenate.

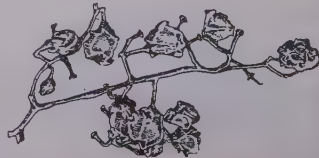
**Sphinx and Other Caterpillars**—Several species of horn worms as well as other kinds of caterpillars feed upon the leaves. Spray with lead arsenate or practice hand picking.

**Grape Leaf-Hopper**—Small, yellow and red-marked leaf-hoppers sucking sap from under side of leaves. Spray under surface with nicotine solution and soap.

**Grape Phylloxera**—Sucks sap from roots and leaves, forming galls, and causing serious injury to European varieties. Graft on native species.

#### *Fungi.*

**Black Rot**—Causes reddish-brown spots on leaves; more rarely on stems; especially bad in rotting the berries, which finally become hard, shrunken and wrinkled, black mummies. This is one of the worst diseases of the grape and often difficult to control by spraying, which must be thorough, especially the first season. Begin



spraying before blossoming time, about the last of May, with second application just after blossoming and subsequent sprayings at intervals of about 10-14 days. Use Bordeaux up to the last of July and then change to Soda Bordeaux or Amm. Sol. Cop. Carbonate, though usually the 4 or 5 sprayings with Bordeaux are sufficient. Repts. 1889, p. 174; 1890, p. 100.

**Downy Mildew**—Develops usually dense white patches of fruiting threads on under side of leaves and causes more or less discoloration on the upper; also occurs somewhat on stems and fruit. Treat as for black rot. Rept. 1893, p. 77.

**Gray Mold**—Causes rotting of ripening greenhouse grapes, covering them with a more or less conspicuous grayish mat of fruiting threads. Remove rotting grapes from the house. Use care in ventilating and watering. If necessary spray bunches several times with potassium sulphide.

**Powdery Mildew**—Produces a cobweb-like growth over upper surface of leaves; most conspicuous in the fall, when the minute, round, yellowish to black fruiting-bodies are found scattered over surface. Treat as for black rot. Potassium sulphide is also used effectively against this fungus. Repts. 1895, p. 185.

#### *Insects.*

#### **GRASS.**

**White Grubs**—White grubs are the larvae of June beetles, and when abundant in the soil and approaching maturity, cause much damage, especially in seasons following drought, by eating off the roots of grass, corn, strawberries, etc. Plow just before October 1st to expose insects. Harrow very thoroughly before planting. Repts. 1912, p. 288; 1915, p. 179.



**Fall Army Worm**—Attack similar to that of army worm but occurs in September instead of July, and is more apt to be con-



fined to lawns and millet. The worm does not migrate in such great numbers from one field to another. Same remedies apply. Also practice late fall plowing. Rept. 1912, p. 284.



**Army Worm**—In certain seasons grasses and grains are stripped of leaves and heads during July by brown striped caterpillars, which when abundant move like armies from one field to another often causing great damage. Spray with lead arsenate, strips of grass or grain to protect fields not attacked. Plow deep furrows across line of march, turning the furrow towards the line. Sprinkle migrating worms with kerosene. Use poisoned bran mash. Rept. 1914, p. 157.

## HICKORY.

*Insects.*

**Fall Web-Worm**—See Pear.

**Walnut Caterpillar**—See Walnut.

**Hickory Tussock Moth**—White and black hairy caterpillars feed upon the leaves in late summer. Spray with lead arsenate. Repts. 1907, p. 332; 1917, p. 325.

**Hickory Bark-Beetle**—Small black beetles breed under bark and the galleries soon girdle the tree. Adults emerge, leaving numerous round holes as if the bark had received a charge of bird shot. Beetles also feed at base of compound leaf stems causing them to break and fall in midsummer. Has killed thousands of trees in Atlantic States. Badly infested trees should be removed before May 1st, and burned or at least the bark removed. Spray healthy and slightly infested trees about June 1st, with strong lead arsenate and nicotine solution. Repts. 1901, p. 267; 1914, p. 198.

**Hickory Borer**—Larvae tunnel deep into solid wood of trunk. Hunt for sawdust, find the burrow, inject carbon disulphide, and plug the entrance.

**Nut Weevils**—Larvae infest the fruit or nuts. See Chestnut.

**Hickory Gall Aphid**—Curious galls on the leaf stems often cause the leaves to fall in midsummer. Galls contain large numbers of aphids. Spray with nicotine solution just as new growth starts in spring. Rept. 1916, p. 145.



## HOLLYHOCK.

*Fungi.*

**Rust**—Appears as small, compact, reddish-brown outbreaks on both leaves and stems. After their death in fall, cut off the plants close to the ground, carefully gather up these and any rubbish that may contain spores, and destroy them. Spraying with Bordeaux is recommended by some as helpful in checking the rust; begin as plants push through ground. Rept. 1895, p. 188.

## HOP.

*Insects.*

**Hop-Vine Borer**—Larva tunnels in tip, checking growth, and later in the stem above and below the surface of the ground. Crush larvae in the tips, remove soil from the base, and after leaving the main roots exposed for a week, apply wood ashes or ammoniated phosphate and hill up. The plants will make new roots.

**Hop-Vine Snout Moth**—Green, white-striped larvae feed upon the leaves in June. Spray with lead arsenate while the larvae are small.



**Hop-Merchants**—Brown, spiny caterpillars of two species of tortoise-shell butterflies feed upon the leaves. Spray with lead arsenate.

**Hop Aphid**—Green aphids suck the sap from the under leaf surface. Spray with kerosene emulsion.  
*Fungi.*

**Powdery Mildew**—Coats leaves and stems with whitish powdery growth, the mature fruiting bodies finally showing as loosely imbedded blackish specks. Found here so far only on ornamental varieties. Make several sprayings with commercial lime-sulphur. Rept. 1911-12, p. 349.

#### HORSE CHESTNUT.

*Insects.*



**White-Marked Tussock Moth**—Tufted caterpillars devour leaves in midsummer. Spray with lead arsenate. Repts. 1905, p. 230; 1916, p. 105.

*Fungi.*

**Leaf Spot**—Forms extended reddish-brown areas on the leaves, frequently resembling sun scorch, but showing the fruiting stage as minute black dots in the dead tissues. This trouble can no doubt be controlled by spraying with Bordeaux. The first application is made on the unfolding leaves and is followed by one or two subsequently at intervals of about 2 weeks.

#### HORSE RADISH.

*Insects.*

**Flea Beetle**—Adults feed on the leaves, and larvae tunnel in the petioles. Spray with Bordeaux mixture and lead arsenate.

#### IRIS.

*Insects.*

**Iris Root Borer**—Larva tunnels in the rootstocks injuring many plants. Destroy infested rootstocks. In bad infestations burn

over the beds in winter to destroy the eggs. Repts. 1915, p. 189; 1918, p. 331.

*Fungi, etc.*

**Leaf Blight**—Forms elliptical spots with purplish border; if abundant causes leaves to turn yellow and die prematurely; worst on German Iris. Keep foliage coated with Bordeaux or lime-sulphur, beginning early; gather and burn infected rubbish in late fall.

**Soft Rot**—Attacks rootstocks destroying lower parts so that leaves turn yellow and die. Same bacterial disease described under Salsify. Propagate only from healthy stock; plant in well drained soil; use only well rotted manure; prevent winter injury of roots. Rept. 1903, p. 327.

#### IVY, BOSTON.

*Fungi.*



**Leaf Spot**—Forms conspicuous brownish spots with purplish borders, which run together if abundant. Leaf stage of black rot of grape. Give several sprayings with commercial lime-sulphur, beginning on unfolding leaves. Burn leaves in fall.

*Insects.*

#### KALE.

**Turnip Aphid**—See Turnip.

*Fungi.*

**Black Rot**—Rept. 1915, p. 431. See Cabbage.

*Insects.*

#### LARCH.

**Larch Sawfly**—Larvae defoliate trees in midsummer. Spray with lead arsenate. Rept. 1915, p. 125.

**Woolly Aphid**—White cottony tufts on the bark and at the leaf whorls. Spray with kerosene emulsion.

*Insects.*

#### LETTUCE.

**Aphid or Green-Fly**—Sucks sap from leaves. Fumigate with tobacco or hydrocyanic acid gas. Spray with soap and water.

*Fungi.*

**Drop**—Causes sudden wilting of plants by infecting and rotting off leaves at surface of soil; often shows a white moldy growth over the basal parts. This may develop into a serious trouble in the greenhouse, as the fungus often becomes established in the soil, when the best remedy is to change the soil entirely or sterilize it by steam or formalin (formula D). Treat some days before using. Parsley is also subject to this disease in the greenhouse. Rept. 1908, p. 863.



**Leaf Mold and Mildew**—The first produces a brownish and the second a white moldy growth in spots on the leaves. These diseases are held in check by sub-irrigation or care in watering and ventilating to keep plants and atmosphere as free from moisture as is consistent with good growth.

*Insects.*

#### LILAC.

**Lilac Borer**—A white larva tunnels in the twigs. Cut and burn infested twigs. Rept. 1905, p. 260.

**Oyster-Shell Scale**—See Apple.

**San José Scale**—See Peach.

*Fungi.*

**Powdery Mildew**—Forms whitish cobwebby coating on leaves, with mature stage finally abundant as black dots. Conspicuous and common, but hardly demands preventive treatment.

*Insects.*

#### LILY.

**Aphid**—Yellow plant lice with red markings, on under side of leaves. Spray with nicotine solution and soap.

**Stalk Borer**—See Dahlia.

*Insects.*

#### LINDEN.

**Canker Worm**—See Apple.

**White-Marked Tussock Moth**—See Horse Chestnut.

**Linden Borer**—A white larva tunnels in wood at base of trunk. Dig out borer, or inject carbon disulphide. Rept. 1915, p. 186.

*Insects.*

#### LOCUST.

**Locust Borer**—Larvae tunnel in solid wood of trunk. When new leaves appear, spray bark of trunk and larger branches with mixture made by dissolving  $\frac{1}{4}$  lb. sodium arsenite in 5 gallons water to which 1 quart of miscible oil is added and the whole thoroughly agitated.

*Insects.*

#### MANGEL.

**Leaf Miner**—See Beet.

*Fungi.*

**Leaf Blight**—Shows as grayish circular spots with purplish borders; when abundant causes premature death of leaves. Rotate; keep refuse out of manure piles; if necessary spray with Bordeaux before disease gets started. Rept. 1915, p. 432.



**Root Rot**—Rots off roots below ground, turning foliage yellow and often killing it. Not common, but injurious occasionally in low wet fields. Avoid wet ground; keep rotted plants out of manure. Rept. 1915, p. 433.

## MAPLE.

**Maple Borer**—Larva tunnels in spiral course upward around trunk or larger branches of sugar maple working in sapwood and cambium, often girdling the trees. Examine trees in September for sawdust. Find the burrow, inject carbon disulphide and plug the opening. Rept. 1907, p. 336.

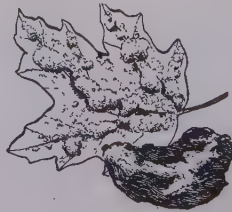


**White-marked Tussock Moth**—See Horse Chestnut.

**Other Tussock Moths**—See Apple.

**Canker Worms**—See Apple.

**Woolly Maple Leaf Scale**—Cottony or woolly masses of wax, containing the females, eggs and sometimes larvae, appear on the under side of the leaves in midsummer; insects suck out the sap causing leaves to fall prematurely. Males and larvae enter crevices of bark of trunk and branches; larvae make cases here and pass the winter. Attacks only sugar maples. Spray dormant trees with nicotine solution and soap. Burn all infested leaves. Bull. 151; Repts. 1905, p. 226; 1911, p. 345.



**Cottony Maple Scale**—Large, oval, brown soft scales on bark of branches of silver and red maples. Each scale in early summer develops a large cotton-like tuft of wax, nearly half an inch long, and soon after the young appear. Spray with miscible oils. Bull. 151; Repts. 1905, p. 237; 1913, p. 252.

**Terrapin Scale**—Small reddish-brown soft scales on small twigs of silver and red maples, sometimes killing the branches. Spray with kerosene emulsion. Bull. 151; Rept. 1905, p. 238.

**Oyster-Shell Scale**—See Apple.

**Maple Aphids**—Green aphids are common on under surface of leaves of Norway and Sycamore maples in June. Spray with nicotine solution and soap, or with kerosene emulsion.

**Gall Mites**—Disfigure leaves by forming galls on upper surface. Destroy infested leaves.

*Fungi, etc.*

**Anthraxnose**—Causes more or less extended dead areas in the leaves, often hard to distinguish from the leaf scorch. Its appearance depends on character of season and is difficult to foretell, but only occasionally serious. For this reason spraying is of doubtful value in the long run, but when made should start on the unfolding leaves. Repts. 1903, p. 329; 1915, p. 436, unusual form.

**Black (Tar) Spot**—Forms slightly thickened black spots on the leaves, resembling finger prints. Cut-leaf maples are especially susceptible. Rake up and burn all leaves in the fall. Rept. 1908, p. 852.

**Leaf Scorch**—Causes more or less extended and irregular dead areas to appear suddenly, usually from the leaf margins inward. A physiological trouble due to sudden or excessive evaporation beyond the supply of water furnished by the roots, which is in turn due to abrupt changes in atmospheric conditions, drought, injury to roots, etc. Pruning, when necessary, watering or mulching, and stimulating root growth by nitrogenous fertilizers are probably best remedial measures. Rept. 1905, p. 267.



**Stag-head**—Kills trees at the top or large central branches gradually die. Due to various agents or unfavorable environment such



as parasitic or semiparasitic toadstools and shelf-fungi, escaping gas in soil, winter injury, etc. Cut off dead and dying branches, clean out decaying wood, treat with a wood preservative and if necessary fill cavities. Stimulate new growth by nitrogenous fertilizers.

*Insects.*

#### MARGUERITE.

**Marguerite Fly or Leaf Miner**—A maggot tunnels between upper and lower leaf surfaces. Spray every ten or twelve days with nicotine solution. Rept. 1915, p. 188.

*Insects.*

#### MELON (MUSK).

**Melon Aphid**—Sucks the sap from the under side of the leaves, and when abundant causes much damage. Underspray the leaves with nicotine solution and soap. Bull. 216, p. 47; Rept. 1908, p. 813.

**Striped Cucumber Beetle**—See Cucumber.

*Fungi.*

**Anthrachnose**—Appears occasionally. See Cucumber and Water-melon.



**Downy Mildew**—Forms angular, eventually brown spots in the leaves, often stunting or killing vines; most prominent just before melons ripen, later ones often not maturing or worthless because lacking flavor. It is questionable whether this trouble can be controlled effectively and profitably by spraying during a very moist season. During dry or semi-moist seasons, however, results are satisfactory, so we recommend spraying as one of the regular operations of melon growing. It should be started soon after the vines begin to run, at least by the middle of July, and the vines should be kept covered with the Bordeaux to the end of the season. Rept. 1904, p. 329.

**Leaf Mold**—Develops dead spots on the leaves very similar to those caused by downy mildew. Spray with Bordeaux on the first running vines and repeat every 10 to 14 days, making 4 or 5 applications according to season. Repts. 1895, p. 186; 1898, p. 225.

**Wilt**—See Squash.

*Insects.*

#### MILLET.

**Fall Army Worm**—See Grass.

*Insects.*

#### NASTURTIUM.

**Aphid**—Brown aphids cluster on stems and leaves sucking the sap. Spray with nicotine solution and soap.

*Insects.*

#### OAK.

**Canker Worms**—See Apple.

**Brown-Tail Moth**—See Pear.

**Orange-striped Oak-Worm**—Black and orange striped caterpillars feed upon the leaves late in summer. Spray with lead arsenate.

*Fungi.*

**White Heart Rot**—Forms on trunks shelf-fungi, often somewhat hoof-shaped, eventually with dark, creased and cracked, upper surface and rusty-brown, porous, fruiting, lower surface. Gains entrance through wounded and dead branches; causes white rot of heart wood and slow death of sapwood and bark. Break off and burn fruiting bodies; if feasible cut out diseased bark and sapwood, and dig out dead heartwood and fill cavity with cement. Occurs in other deciduous trees. Bull. 222, p. 446.

*Insects.*

#### OATS.

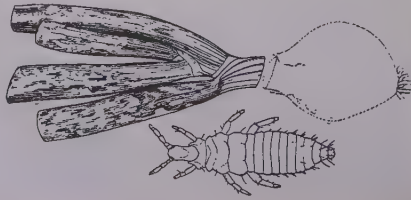
**Army Worm**—See Grass.





**Black Stem Rust**—Forms, chiefly on leaf sheaths and stems, first the II stage as reddish pustules and later the III stage as elongated black outbreaks. Also occurs on wheat, rye, and other grasses as different strains. The I stage appears in spring on barberry leaves as cluster-cups but the fungus can skip this stage. Quite serious in regions where grain is grown extensively, and difficult to control. This and several related species are becoming more important here as more grain of various kinds is grown. Out out berries in vicinity of fields.

**Smut**—Destroys the grain, turning it into a black dusty mass of spores. Seed treatment will prevent this smut. Either soak the seed 8 to 10 minutes in water at 132–5° F., or sprinkle thoroughly with formalin (formula A), stirring the grain so that it is thoroughly wet, and leave in piles for several hours before drying out. A less cumbersome treatment coming into general use is that given under formula B. Buy seed from smut-free fields.



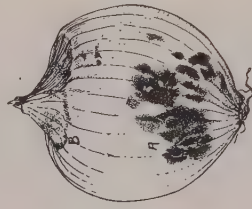
## ONION.

### Insects.

**Thrips or "White Blast"**—Very small insects which feed upon the surface of the leaves, giving the field a whitish appearance. Burn all tops and refuse; burn over the grass land around the field to kill over-wintering insects. Spray with nicotine solution and soap, or kerosene emulsion. Repts. 1903, p. 266; 1913, p. 233.

**Maggot**—Infests the bulb of the young plant. Practice rotation of crops. Spray plants here and there over the field with sweetened lead arsenate to kill the adult flies. Rept. 1911, p. 286.

*Fungi, etc.*



**Anthracnose (Black Spot)**—Produces black circular spots on the bulbs, usually on white varieties after storing in the barn. Store onions as dry as possible and keep barn dry and cool. Avoid piling too deeply in bins. Possibly air-slaked lime mixed with sulphur scattered over them at time of storing may prove beneficial. See Stem Rot for treatment with formalin fumes. Fig. (A). Rept. 1889, p. 163.

**Smut**—Forms black dusty outbreaks on various parts of plants raised from seed; especially injurious to the very young seedlings. This fungus becomes established in the soil, hence infected land should be avoided or used only for transplanted onions. If, however, it is seeded, apply with the seed in drills per acre, 100 lbs. sulphur thoroughly mixed with 50 lbs. air-slaked lime. Formalin (1 lb. or 1 pt. to 12 or 15 gallons water) thoroughly sprinkled over the seed, before covered, by drip attachment to the seeder, is an even more desirable remedy. Repts. 1889, p. 129; 1895, p. 176.

**Stem Rot**—Causes rotting of bulbs at stem end, where they become soft and shrunken, sometimes showing beneath the layers a dense olive-brown growth of mold. This fungus in a moist season occurs on various parts of the plant in

the field (possibly responsible for "blast" of seed onions), but does not usually appear as a serious trouble with the bulbs until some time after they have been placed in the barn. Treat as for black spot. Late field spraying with Bordeaux shortly before pulling and again while lying in the field, combined with treatment by formalin fumes (See Fungicides) after storing, has given some indications of benefit. See Fig. (B) under anthracnose. Repts. 1903, p. 334; 1904, p. 321.

#### *Insects.*

### **PALMS.**

**Scales**—Several kinds of white and brown scales infest the species of palms grown in greenhouses. Apply nicotine solution or soap and water as a spray or as a dip.

#### *Fungi.*

**Anthracnose**—Frequently causes leaves to die at tip. Fungus inconspicuous, may show as small black imbedded specks oozing pinkish masses of spores. Avoid infected stock or isolate it; pick off and burn worst infected leaves; keep leaves dry and house well ventilated. Rept. 1913, p. 18.

#### *Insects.*

### **PARSLEY-PARSNIP.**

**Celery Caterpillar**—On both hosts. See Celery.

**Parsley Stalk Weevil**—Larva tunnels in crown of plant. No remedy other than to destroy infested plants. Rept. 1913, p. 252. *Fungi.*

**Drop**—On Parsley. See Lettuce.

**Soft Rot**—On Parsnip. See Salsify.

#### *Insects.*

### **PEA.**

**Green Pea Aphid**—Attacks the plants early in June and sucks the sap from the leaves and stems, often causing great injury.

Early peas may mature a crop before aphids injure them. Spray vines with nicotine solution and soap. Brush the vines just before cultivating. Repts. 1899, p. 240; 1913, p. 235.

**Pea Weevil**—The adult lays eggs in the pods in the field and the larvae develop in the seed, emerging through round holes. Fumigate with carbon disulphide. Bull. 195, p. 5. *Fungi.*

**Leaf Spot and Powdery Mildew**—The former shows as roundish spots on both pods and leaves; the latter, as a mealy or cobweb-like coating on same. Neither seems to be sufficiently injurious here to warrant the expense of spraying.

**Root-Rot**—Kills tops of roots and base of vines, causing parts above to turn yellow, wilt and die prematurely. Caused by various soil fungi of which the downy mildew was especially prominent in 1919. Practice rotation, use *well-rotted* manure and give frequent cultivation in wet years to hasten the drying of the top soil. Bull. 222, p. 450.

### **PEACH.**

#### *Insects.*

**Peach Saw-Fly**—Larvae feed upon leaves in June and July. Spray with lead arsenate. Rept. 1907, p. 285.



**Peach Borer**—Larva tunnels in the base of the trunk. Dig out in late fall and early spring. Paint base of trunk with lead arsenate and lime-sulphur. Remove top soil and sprinkle powdered paradichlorobenzene around the trunk, using about 1 ounce per tree and cover with soil. Rept. 1909, p. 359.

**Fruit Bark-Beetle or Shot-Hole Borer**—Makes minute tunnels under the bark of branches and trunk. Burn infested trees and keep others thrifty. Rept. 1896, p. 240.

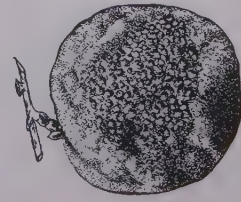


**Plum Curculio**—See Plum.

**San José Scale**—Minute scale insects, with circular shell, which suck the sap from twigs, fruit and leaves. On fruit a red spot surrounds each insect. Spray dormant trees with lime-sulphur. Bull. 165; Rept. 1901, p. 240.

**Black and Green Aphids**—Suck the sap from the leaves and shoots. Spray with nicotine solution.

*Fungi, etc.*



**Brown Rot**—Occurs on the young twigs, etc., but causes most serious injury to the fruit, rotting it about the time of its maturity. The rotten areas usually become covered with numerous pustules of dusty brownish spores; eventually the diseased fruits form hard mummies. These carry the fungus over the winter, and if half buried in the soil develop in early spring the mature stage, which causes infection of the blossoms, etc. Certain early varieties, like the Champion, are especially subject to rot. Spraying these apparently pays in this state. See general directions for treatment. This fungus occurs on plums and cherries and less commonly on pears and apples. Repts. 1909-10, pp. 607, 612; 1911, pp. 374, 391.

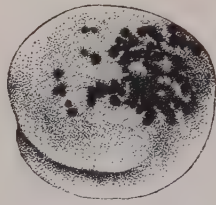
**Crown Gall**—See Plum.

**Leaf Curl**—Causes young leaves to become irregularly curled and swollen and finally to drop off; rarely on fruit. In April as soon as buds begin to swell, spray the trees thoroughly with commercial lime-sulphur 1-9. If more convenient this may be done in late fall and is claimed to be just as effective. Same treatment takes care of San José scale. Repts. 1909-10, pp. 608, 612; 1911, p. 374; 1914, p. 19.



**Powdery Mildew**—Forms a grayish felt on young twigs and leaves. Prune off infected twigs. Give winter treatment as for leaf curl, and, if necessary, summer treatment as for scab and brown rot.

**Scab**—Produces roundish, olive-black spots on the fruit, discolored areas on the young twigs, and rarely "shot-holes" in the foliage. Two treatments with self-boiled lime-sulphur or atomic sulphur upon the fruit after setting and when half grown (about the middle of May and June) will control this trouble. Repts. 1896, p. 269; 1909-10, pp. 608, 614; 1911, pp. 375, 391.



**Spray Injury**—Is more likely to occur than with same treatment on apple, *q. v.* Avoid Bordeaux altogether. See (3) under general treatment following. Repts. 1900, p. 219; 1911, p. 372.

**Winter Injury**—Shows in various ways. In severe winters, especially when the ground is bare, the roots may be killed without injury to parts above the ground. In spring such trees put forth a scanty sickly foliage that soon drops. Often the injury occurs in the form of a "collar girdle" in the bark at the base of the tree. Sometimes it occurs above ground in the wood (shown by



its blacker color), with or without injury to the bark. When the bark is not injured, severe pruning in spring will often save the trees. Nursery trees can sometimes be cut back to the snow line, below the injury, and an entirely new healthy trunk started. Avoid late applications of nitrogenous fertilizers and cultivation after middle of July. Mulch base of young trees in late fall with earth. Secure good drainage. See Apple. Repts. 1903, p. 341; 1908, p. 872.

**Yellows**—Causes premature ripening and red spotting of fruit with yellowish curled leaves, and in time spindling sprout growths in bunches on the trunk. This is claimed to be a contagious disease, but it is apparently physiological in nature. Little peach in this state is scarcely to be distinguished from yellows, showing chiefly in the small backward fruit. Root out and burn all trees as soon as found; prevent winter injury; be careful in selecting stock for planting. Nurserymen should use especial care in selecting their stock for budding. Repts. 1893, p. 92; 1908, p. 872.

#### *General Treatment for Peach Orchards.*

(1) Spraying of peaches while dormant is of value only in checking San José scale, mites and leaf curl. One application of commercial lime-sulphur, 1-9, either in late fall or early spring, will take care of all of these troubles at the same time. If the scale and the leaf curl are unusually prevalent, both applications will prove of value in controlling them.

(2) For the prevention of scab and rot of peaches, it is as a rule desirable to give three sprayings, as follows: 1st, shortly after the blossoms have fallen (May 15th to May 25th); 2nd, about three or four weeks later (June 5th to June 15th); and 3d, about one month later (July 5th to July 15th). If only two sprayings can be given, omit the first if spraying only for rot, and the last if spraying only for scab.

(3) On the whole, self-boiled lime-sulphur of the 8-8-50 formula or atomic sulphur seem to be the safest and most reliable peach

sprays. Fair results have been obtained with some of the commercial lime-sulphurs, and they are much more easily handled. There is, however, some danger of spray injury, especially with certain brands. If commercial lime-sulphur is used, a strength of not greater than 1-150, without poison, is recommended.

(4) As lead arsenate has done little to prevent curculio injury, and as it seems to increase the danger of spray injury, we advise leaving it out unless there is considerable danger from the sawfly, when it can be added in the second spraying the same as for apples.

### **PEAR.**

*Insects, etc.*

**Pear or Cherry Slug**—See Cherry.

**Codling-Moth**—See Apple.



**Brown-Tail Moth**—Occurs in the United States only in eastern New England. Brown hairy caterpillars feed on leaves, and make winter nests on twigs, maturing about the middle of June. Cut and burn winter nests. Spray foliage as soon as blossoms fall, and also in August, with lead arsenate. Rept. 1910, p. 683; Bull. 182.

**Fall Web-Worm**—Makes nests on ends of branches of many kinds of trees in late summer, the brown, hairy caterpillars feeding inside the nests. Clip off and burn nests when small. Spray with lead arsenate. Repts. 1901, p. 270; 1917, p. 319.

**San José Scale**—See Peach.

**Pear Psylla**—Small jumping plant lice suck sap from leaves and twigs, causing leaves to fall in midsummer. Spray with lime-



sulphur in spring just before buds open. Spray infested trees with nicotine solution and soap in July. Rept. 1903, p. 262.

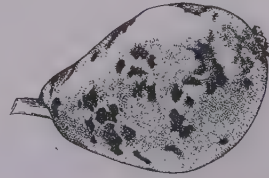
**Pear Thrips**—A minute insect which feeds upon the unopened fruit buds destroying them so that fruit does not set. Spray with nicotine solution and soap just as buds open, and again after blossoms fall.

**False Tarnished Plant Bug**—Punctures developing fruit causing it to be irregular and knotty. Spray with nicotine solution and soap.

**Leaf Blister Mite**—Attacks unfolding leaves of apple and pear; forms galls or blisters which become red and later brown. Causes many leaves to fall in July. Spray dormant trees with lime-sulphur in late fall or in spring. Rept. 1910, p. 700.

*Fungi, etc.*

**Scab**—Forms olive-black scabby spots on fruit and leaves, often causing the former to become distorted and cracked. The fungus lives over winter on the twigs. Certain varieties are not much injured, others, like Flemish Beauty, are very susceptible. Spray with Bordeaux on unfolding leaves before blossoms open, again after petals fall, and give the third spraying about two weeks later, using weak Bordeaux in last two treatments. Repts. 1894, p. 135; 1904, p. 323; 1911, p. 396.



**Blight**—Kills young twigs, the leaves suddenly turning black; also produces sunken dead areas on trunks. This is a bacterial disease chiefly spread by bees during blossoming time, or by sucking insects. Winter-prune all diseased branches, cutting off several inches below the diseased area. Cut out cankered areas and swab with disinfectant, paint exposed wood when dry. Several times after blossoming remove all young dead twigs. Use knife

sterilized from time to time by wiping with a cloth saturated with carbolic acid or with corrosive sublimate (1-1000). This disease occurs also on apple and quince. Rept. 1894, p. 113.

**Leaf Blight**—See Quince.

*Insects.*

#### PEONY.

**Rose Chafer**—Adult beetles feed upon blossoms of white varieties. See Grape.

*Insects.*

#### PHLOX.

**Red Spider**—Injures leaves causing them to turn yellow. Clean culture. Spray clear water with force from hose, and in severe infestations, with kerosene emulsion, or with nicotine solution and soap.

*Fungi.*

**Powdery Mildew**—Covers more or less completely leaves and young stems with grayish coating within which are finally imbedded numerous, small, blackish fruiting-bodies. Give several sprayings with commercial lime-sulphur, starting before mildew gains much headway.

*Insects.*

#### PINE.

**Sawflies**—Larvae of several native and imported species feed upon the leaves. Spray with lead arsenate. Rept. 1917, p. 273.

**White Pine Weevil**—Adult snout beetle lays eggs on leader in May and grubs feed and develop in it, causing it to wilt and die in midsummer. Leaders of ornamental trees may be protected by spraying them with lead arsenate or lime-sulphur. Jarring the adults into a net once a week during month of May, serves to greatly reduce the damage. Infested leaders should be cut and destroyed. Repts. 1911, p. 307; 1919, p. 144.

**Pine Leaf Scale**—Whitish pear-shaped shells on leaves; small trees sometimes killed. Spray with nicotine solution or kerosene

emulsion about the second week in June. Bull. 151; Rept. 1905, p. 240.

**Pine Bark Aphid**—White cottony or woolly objects on bark and sometimes on leaves, sucking out the sap. Spray with kerosene emulsion. Repts. 1911, p. 343; 1919, p. 155.

*Fungi, etc.*

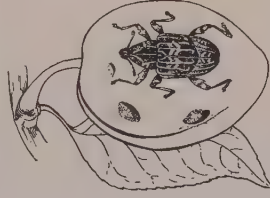
**Blight** (so-called)—Stunts the leaves and kills their tips inward, often suddenly, so that the tissues for a greater or less distance are reddish-brown. This is a physiological disease; not contagious; due to adverse weather conditions. Chief among these are severe winters, killing the leaves directly or indirectly through injury to roots; warm days, in late winter or early spring when ground is frozen, causing transpiration of water from the leaves that cannot be replaced; very late spring frosts, killing tips of new leaves; sudden changes, in summer from moist or muggy weather to bright sunshine resulting in excessive transpiration and injury; very dry summers. No effective remedy. Rept. 1907, p. 353.

**Dampening Off**—Caused here chiefly by *Rhizoctonia* fungus rotting base of the stem, the seedling falling over. Sometimes it creeps up the stem invading the base of the leaves which wither. Certain conifers are more subject to attack than others. Avoid unnecessary watering; provide good ventilation; infected soil often can be helped by treatment with formalin before seeding (see *Fungicides*, formalin D); spraying with Bordeaux is effective in some cases. Repts. 1912, p. 348; 1915, p. 450.

**Stem Rusts**—Form on the swollen stems temporary, but conspicuous, white, blisterlike spore cups filled with a dusty orange-colored spore mass. The white pine blister rust, an imported species, spreads to the gooseberries and currants, and forms other less conspicuous leaf stages on these (*q. v.*). A very similar native species on two and three needle pines spreads to the leaves of the sweet fern. In either case infected pines should be destroyed,



San José Scale—See Peach.



*Fungi.*

**Black Knot**—See Cherry.

**Brown Rot**—Thin fruit so it does not touch. Gather and destroy all mummies after harvest. Rather difficult to control

and watch kept of the alternate hosts, if they occur in the neighborhood. Seed beds should never be made in the vicinity of the alternate hosts, as infection takes place easily in the young pine seedlings. Spray beds with Bordeaux if liable to infection. In white pine plantations pull out all currants and gooseberries including those in the immediate neighborhood (500 feet). Send any suspicious white pines or their alternate hosts to this Station for examination. Rept. 1912, p. 347; Bull. 214, p. 428.

## PLUM.

*Insects.*

**Plum Aphids**—Suck sap from leaves. Spray with kerosene emulsion, nicotine solution and soap, or with soap and water.

**Plum Curculio**—Grub infests the growing fruit, causing it to fall. Jar the trees each morning for six weeks after blooming and catch the beetles on sheets and destroy them. Spraying with lead arsenate during the same period is also advised. Rept. 1910, p. 609.

**Fruit Bark-Beetle** or **Shot-Hole Borer**—See Peach.

by spraying, as spray does not readily adhere to the smooth fruit. First treatment with self-boiled lime-sulphur, should be made on half grown fruit, others at intervals of two weeks, and the last one 10-14 days before picking. See Peach.

**Crown Gall**—Forms hard roundish knots one-half inch or more in diameter, near crown or on roots, less frequently on lower part of trunk. Do not plant infected trees. Remove knots when found and paint over cut surface. This is said to be very troublesome in some states, but here, as yet, little damage has resulted from it except possibly on blackberries and imported roses. It also occurs on peach, apple, raspberry, and various ornamental plants.

#### POPLAR.

*Insects.*

**Poplar Tent-maker**—Larvae feed on leaves and fold them together near ends of branches, forming nests. Spray with lead arsenate. Rept. 1911, p. 310.

**Spiny Elm Caterpillar**—See Elm.

**Tussock Moths**—See Apple, Hickory and Horse Chestnut.

**Poplar Borer**—Larvae make large galleries in wood of trunk. Dig out, or inject carbon disulphide into the burrow and close the opening. Rept. 1907, p. 336.

**Poplar and Willow Curculio**—Larva tunnels in smaller trunk and branches. Destroy badly infested trees. Cut out borers; inject carbon disulphide. Rept. 1907, p. 335.

**Oyster-Shell Scale**—See Apple.

*Fungi.*

**European Canker**—Forms sunken dead areas of varying extent in the bark. Importation from Europe; showing here most commonly on Lombardy and white poplars. If trees are badly injured cut down and burn; otherwise cut out diseased areas

going into the healthy bark, scraping and painting over exposed wood if surface is extended. Bull. 222, p. 461.

**Rusts**—Show on leaves as minute, powdery, yellow-orange pustules in II stage, and as slightly elevated reddish blisters in III stage. Have I stage, for different species, on larch and hemlock. Avoid planting near these hosts in nursery; rake up and burn infected leaves in the fall. Rept. 1915, p. 440.

#### POPPY.

*Insects.*

**Aphids**—Black aphids suck sap from stems and leaves. Spray with nicotine solution and soap.

#### POTATO.

*Insects.*



**Flea Beetle**—Small black jumping beetles eat holes through the leaves. Spray heavily both upper and under leaf surfaces with lead arsenate or calcium arsenate. Bull. 208, p. 103; Rept. 1906, p. 271.

**Colorado Beetle**—Adults and larvae devour the leaves. Spray with lead arsenate as soon as injury is apparent. May be used in Bordeaux mixture. Bull. 208, p. 106; Rept. 1911, p. 311.

**Three Lined Potato Beetle**—Larvae feed upon the leaves and carry their black excrement on their backs. Spray with lead arsenate. Bull. 208, p. 109.

**Stalk Borer**—Larva tunnels inside the stalk. Burn infested vines. See Dahlia. Bull. 208, p. 111.



**Potato Aphid**—Green and pink aphids appearing in large numbers suck the sap from shoots and stems, causing much damage in 1917. Spray with soap and nicotine solution. Bull. 208, p. 115.



*Fungi, etc.*

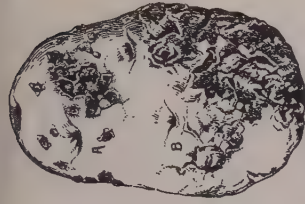
**Black Leg**—Causes a black rot of stem below ground; plants more or less stunted with yellowish curled foliage; occasionally rots tubers. Usually only scattered plants appear in the field, not spreading to the healthy. Soaking seed in formalin as for scab said to be helpful. Rept. 1914, p. 21.

**Blight or Downy Mildew**—Causes a sudden blackening of the leaves, and often death of vines, from July to September in moist seasons; usually shows a slight whitish growth of fungus on the under side of the leaves; rots tubers. Spray with Bordeaux before the trouble appears, about July 1st, and keep vines well covered to the end of the season. Three to five sprayings by hand or five to seven by power sprayer are necessary. After last cultivation thoroughly ridge up the rows to help keep the spores from washing down to the tubers. Early varieties often escape blight by maturing before its appearance. Repts. 1904, p. 363; 1905, p. 304; 1909-10, p. 739; 1915, p. 470; 1916, p. 355; Bull. 214, p. 411.



**Mosaic**—Shows as a more or less conspicuous yellow-green mottling of the leaves. A physiological disease not well understood. New here but apparently not so injurious as in some other places. Do not save tubers for planting from hills showing this trouble. Bull. 222, p. 464.

**Scab**—Produces the common scabby appearance on surface of tubers. Soak uncut seed-tubers one hour in formalin (formula C). Formalin fumes (see Less-Used Fungicides) are often used when large quantities are treated. Care in filling space sufficiently, however, is necessary to avoid injury by “pitting” from absorption of fumes. Corrosive sublimate is again recommended by some investigators especially where the black scurf (*Rhizoctonia fungus*) also occurs on the tubers, as this treatment seems more effective against the latter. Hot corrosive sublimate or formalin for short periods has also been recommended for potato tuber diseases. Avoid planting on infected land, by systematic rotation. The use of lime, wood ashes, and various barnyard manures will increase the amount of scab. The same trouble occurs on beets and turnips. Fig. (B). Repts. 1890, p. 81; 1891, p. 153; 1894, p. 118; 1895, p. 166; 1896, p. 246; 1909-10, p. 744.



**Tip Burn**—Causes leaves to die at tip and margins and roll up; often mistaken for true blight. This is a physiological trouble due to drought or sudden change from moist to very hot bright weather. Cultivate thoroughly and often to conserve moisture. Spray with Bordeaux as for blight, as this often helps to increase yield by lengthening life of leaves. Rept. 1909-10, p. 742.

*Insects.*

## PRIVET.

**Privet Leaf Folder**—Larvae web together terminal leaves and feed inside. Clip off and destroy infested shoots. Spray with lead arsenate. Rept. 1913, p. 223.

**Privet or Lilac Borer**—See Lilac.



*Fungi, etc.*

**Anthraxnose**—Forms small cankers on stems causing parts above to wilt and die. Usually found in nurseries on recently transplanted European privet. Prune off and burn infected branches; if bad spray with Bordeaux. Rept. 1914, p. 22.

**Winter Injury**—Shows in spring by stems usually being killed down to base or snow line. Cut off dead stems below injury and a vigorous new growth will result if roots are not injured. Rept. 1904, p. 326.

*Insects.*

#### QUINCE.

**Round-Headed Borer**—See Apple.

**Quince Curculio**—Grubs infest growing fruit and adults feed upon it causing it to be knotty. Jar the trees same as for plum curculio. Spray with lead arsenate.

**Aphid**—See Apple.

*Fungi, etc.*

**Black Rot**—Rots the fruit, often beginning at the blossom end; also kills twigs and branches. In the fall or spring cut off and burn all dead branches. Give three sprayings, as for leaf blight, with Bordeaux mixture.

**Blight**—See Pear.

**Leaf Blight**—Forms rounded, often confluent, reddish-brown spots with central black dots on leaves and fruit, the former often shedding prematurely and the latter cracking irregularly. Spray with Bordeaux just before blossoms open, again soon after they fall, and follow with 1 or 2 additional treatments at intervals of about 2 weeks, according to the weather. This fungus also occurs on pear. Repts. 1890, p. 99; 1891, p. 150.

**Rust**—Produces small clustered cups, with fringed borders and filled with orange spores, on fruit, young twigs and less frequently

on leaves. Cut off and burn infected twigs and fruit. Look for infected cedars in neighborhood. See Apple Rust.

*Insects.*

#### RADISH.

**Maggot**—See Cabbage.

**Aphid**—See Turnip.

*Fungi.*

**Club Root**—See Cabbage.

*Insects.*

#### RASPBERRY.

**Raspberry Sawfly**—Larvae devour leaves. Spray with lead arsenate or hellebore. Rept. 1918, p. 329.

**Cane Borer**—Larva tunnels inside the canes. Cut and burn infested canes.

**Raspberry Fruit-Worm**—Brown beetles feed upon buds, leaves and blossoms, and white larvae adhere to berries at picking time. Spray with lead arsenate when beetles first appear.

*Fungi, etc.*

**Anthraxnose**—Shows as more or less confluent whitish spots, with purplish borders, on the stems. In spring, before buds swell, cut out and burn all badly infected canes and then spray with Resin-Bordeaux. If disease is very bad, spray again when young shoots are about six inches high, and repeat in 10 to 14 days. Aim chiefly to cover the young shoots with the spray. After fruit is gathered, again remove any badly infected canes. Cultivate ground thoroughly to promote vigorous growth of canes. Rept. 1899, p. 274.

**Crown Gall**—See Blackberry.

**Rust**—See Blackberry.

**Wilt**—Forms cankered areas on the canes causing the parts above to wilt. In the old canes and near the pruned ends, the fungus often develops a brownish coating of spores around each small imbedded fruiting receptacle. The green berries often dry up without apparent cause, due to inoculation by insects. Spraying has not proved very satisfactory. Old and diseased canes should be removed and burned after the fruiting season and again early in spring. Rept. 1906, p. 321.

**Yellows**—Causes foliage to become more or less crinkled, and mottled with a sickly yellowish color. Plants gradually become worthless. Spraying does not seem to help this trouble, which apparently is of similar nature to peach yellows. Dig out plants with the yellows. Propagate only from perfectly healthy ones.

#### *Insects.*

### **RHODODENDRON.**

**Rhododendron Lace Bug**—This bug sucks the sap from the under side of the leaves, which are usually colored brown by its excrement. Spray with nicotine solution or kerosene emulsion. Rept. 1910, p. 708.

#### *Fungi, etc.*

**Leaf Scorch**—Shows as dead marginal areas of varying width usually appearing suddenly. Plant in shade; keep ground mulched; water if necessary in dry weather by soaking ground beneath mulch. Rept. 1914, p. 23.

#### *Insects.*

### **ROSE.**

**Rose Slug**—Eats away the green portion of the leaves. Spray with hellebore, lead arsenate or nicotine solution.

**Rose Midge**—Larvae distort young leaves and flower buds in greenhouses. Apply tobacco dust to the soil and fumigate nightly with tobacco stems or nicotine paper.

**Rose Chafer**—See Grape.

**Leaf-Hopper**—Sucks the sap from the under side of the leaves. Spray with nicotine solution and soap.

**Rose Scale**—Whitish circular shells on the stems contain insects which suck the sap. Cut and burn worst infested canes. Spray with nicotine solution and soap. Bull. 151, p. 11; Rept. 1905, p. 241.

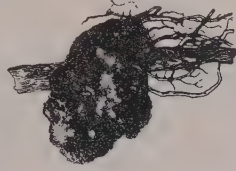
**Aphid or Green Fly**—Sucks sap from the leaves and stems. Spray with nicotine solution.

#### *Fungi, etc.*

**Crown Gall**—Occurs very frequently on rose roots, especially those of Manetti stock. There is some question how much infected plants eventually suffer. See Plum. Rept. 1911-12, p. 355.

**Leaf Blotch**—Forms large purple-black blotches on leaflets, which often turn yellow and fall off. For greenhouse treatment paint hot water pipes with mixture of sulphur and oil. Potassium sulphide or commercial lime and sulphur can be sprayed on the foliage. Spraying out of doors can be done with Bordeaux, if there is no objection to the sediment on leaves. Rept. 1903, p. 355.

**Mildew**—Develops a white powdery or cobweb-like growth on the young leaves, which become more or less distorted and fall off; occasionally blasts blossoms of certain varieties. Tea roses especially susceptible. Treat same as for leaf blotch; or dust flowers of sulphur over the leaves; be careful in airing greenhouses. Rept. 1903, p. 356. Bull. 222, p. 474.



## RUTABAGA, See TURNIP.

### RYE.

*Insects.*  
**Army Worm**—See Grass.  
**Wheat Midge**—See Wheat.



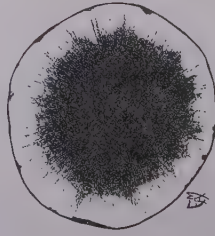
*Fungi.*

**Ergot**—Forms conspicuous, elongated, purplish sclerotia, usually one in the spike, most common in volunteer rye, but occasionally in cultivated fields. Keep these sclerotia out of cattle feed as they may cause abortion and other troubles.

**Powdery Mildew**—Shows as a thick grayish felt on the leaves with fruiting bodies as blackish embedded specks. Causes premature death of leaves; often associated with rust. No practical remedy. Rept. 1909-10, p. 735.

### SALSIFY.

**Soft Rot**—Forms a soft rot of the interior tissues of the roots running down from the crown and turning them a darker color. Usually occurs after storage. Same bacteria cause soft rots in a variety of plants. Avoid contaminated manure and too much rotting humus in the fields; store under dry cool conditions, allowing sufficient ventilation. Rept. 1914, p. 25.



*Fungi, etc.*

### SNAPDRAGON.

*Insects, etc.*

**Leaf Mites**—Cause leaves to curl and plants do not blossom. Spray with nicotine solution and soap, same as for Cyclamen. Rept. 1914 p. 176.

**Root-Knot Eelworm**—Causes irregular swellings on the roots where the eelworms are present, with resulting premature decay and sickly appearance of parts above ground. Worst in greenhouses and hot-beds as this far north the nematodes are killed in unprotected ground over winter. Attacks roots of a great variety of cultivated plants. Pursue only healthy plants; change infected soil if possible, dry out thoroughly in summer, leave out doors over winter or sterilize with steam; avoid contamination of soil with infected refuse. Rept. 1915, p. 452.



*Fungi.*

**Anthracnose**—Shows as whitish spots with distinct purplish border on leaves and stems; spots often running together. Select seed and cuttings only from healthy stock; pick off and burn infected leaves. Spray with Bordeaux.

**Rust**—Forms reddish-brown, roundish pustules chiefly on under side of leaves causing tissues above to become yellow spotted. Appearing in greenhouses and causing more or less injury according to prevalence. Treat as for anthracnose. Rept. 1915, p. 443.

*Insects.*

### SNOWBALL.

**Aphids**—Suck sap from the leaves causing them to curl. Use nicotine solution and soap as a spray or dip.

### SOY BEAN.

*Fungi, etc.*

**Bacterial Leaf Spot**—Forms small, dark, reddish-brown angular spots frequently merging into larger areas. Certain varieties appear more susceptible than others, Ito San being one of the



worst. Grow least susceptible varieties and if possible purchase seed from uninfected fields.

**Crinkling Chlorosis**—Shows as crinkling or yellowish-green mottling of leaves, or both together. Plants less vigorous than normal ones. Hollybrook variety apt to show trouble most. Treatment same as in preceding.

## SPINACH.

*Insects.*

**Spinach or Beet Leaf-Miner**—See Beet.

## SPIRAEA.

*Insects.*

**Aphids**—Suck sap from the new shoots. Use nicotine solution and soap as a spray or dip.

*Insects.*

**Spruce Gall Aphid**—Forms galls at the base of the new growth on Norway and other spruces. Spray in the late fall or early spring with nicotine solution and soap or with kerosene emulsion. Rept. 1906, p. 302.

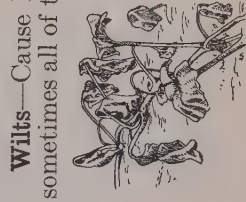
**Spruce Bud Moth**—Larva feeds on leaves of terminal shoots of the branches causing much damage. Spray with lead arsenate. Rept. 1912, p. 291.

## SQUASH-PUMPKIN.

*Insects.*

**Squash Lady-Beetle**—Both adults and larvae devour the leaves. Spray with lead arsenate. Bull. 181, p. 11; 216, p. 42; Rept. 1908, p. 810.

**Striped Cucumber Beetle**—See Cucumber.



**Squash Bug** or "**Stink Bug**"—A brown bug three-fourths of an inch in length sucks the sap from the under side of the leaves, causing them to wilt and die. Spray with kerosene emulsion to kill the young. The old bugs may be trapped by placing boards or shingles on the ground, which should be visited each morning and the bugs killed. Bull. 216, p. 44; Rept. 1908, p. 811.

**Squash-Vine Borer**—Larva tunnels in the base of the stem, causing decay. Cut slits lengthwise in the stem and kill borers. Cover the joints of the vine with earth so that new shoots may be formed to support the plant. Grow a few early plants for traps, and destroy them. The main crop should be planted rather late. Bull. 216, p. 39; Rept. 1908, p. 806.

*Fungi.*

**Anthraco-nose**—See Watermelon.

**Storage Rots**—Caused by various fungi that are best held in check by storage under conditions with minimum of heat and moisture.

**Wilts**—Cause leaves of the plants to wilt and then dry up, sometimes all of the vine thus suddenly dying. If a cross section of the stem shows a slight milky and sticky exudation, it is caused by bacteria that clog up the water ducts. Fungi in the ducts or insects at the roots may cause similar trouble. Heavy manuring often develops these troubles. Spraying is of little value except as it may keep off insects which inoculate the plants with the



bacteria. Use enough seed to allow for loss by wilt and pull up and destroy all the wilted vines as they appear. Rept. 1903, p. 359.

#### *Insects.*

### **STRAWBERRY.**

**Strawberry Sawflies**—Larvae devour leaves. Spray with lead arsenate or hellebore.

**Strawberry Weevil**—Small snout beetles; females cut off blossom buds of staminate varieties when ovipositing. Plant pistillate varieties in part. Dust heavily with lead arsenate and sulphur (1-5.)

**Strawberry Crown Borer**—Grub tunnels and feeds in crown of plant. Practice crop rotation. Burn over infested field in fall.

**Strawberry Flea Beetle**—Adults eat holes through the leaves. Spray with lead arsenate.

**Strawberry Leaf Roller**—Larva rolls leaf and feeds inside. Spray with lead arsenate. Burn fields and plow abandoned fields as soon as crop is harvested.

**Strawberry Root Aphid**—Sucks sap from leaves and roots, killing plants. Set clean plants on land not infested. Spray with nicotine solution and soap.

**Strawberry White Fly**—Sucks sap from leaves. Underspray with nicotine solution and soap.

**White Grubs**—See Grass.

#### *Fungi.*

**Leaf Spot and Blotch**—Cause conspicuous discolored spots, the former usually with whitish centers and purplish borders, and the latter with dark centers. Glen Mary sometimes severely injured by latter fungus. Renew the beds frequently. In the late fall or early spring cut off leaves with mower, add a



little straw where necessary, and burn over beds. Spray with Bordeaux two or three times before blossoming, beginning last of April and repeating weekly, and once after blossoming is over. Repts. 1903, p. 360; 1914, p. 5.

**Powdery Mildew**—Covers leaves (more frequently on under, but more conspicuously, when present, on upper surface) with cobweb-like growth, often causing them to become stiff and curled inward. When necessary, this can probably be controlled with Bordeaux if sprayed before abundant. Rept. 1905, p. 276.

#### *Insects.*

### **SWEET PEA.**

**Aphids**—See Pea.

**White Fly**—See Tomato.

#### *Fungi.*

**Dampening Off**—Rots off stem just below ground causing vines to turn yellow and finally die. Plant in well drained soil; place well rotted manure deep in ground below the seed; avoid excessive watering; spray base of vines and ground with Bordeaux; change beds if appearing yearly. Rept. 1907, p. 359.

#### *Insects.*

### **SWEET POTATO.**

**Tortoise-Shell Beetles**—Feed upon leaves. Spray with lead arsenate. Bull. 208, p. 110.

#### *Fungi.*

### **SYCAMORE.**

**Anthraxnose**—Kills young leaves in the spring; causes dead areas of irregular shape in tissues of older ones often following veins. If thought advisable to spray, use Bordeaux on the leaves as soon as showing and repeat when half grown.

## TOBACCO.

### *Insects.*

**Tobacco** or **Tomato Horn-Worms**—Large green caterpillars with horn on the tail devour the leaves. Practice hand picking or spray the plants with lead arsenate. Rept. 1906, p. 269.

**Flea Beetle**—Adults eat holes through the leaves. Spray upper and under surface heavily with lead arsenate. Bull. 208, p. 103; Rept. 1906, p. 271.

**Cut Worms**—See Tomato.

### *Fungi, etc.*

**Calico**—Causes the leaves to become irregularly mottled with a lighter green color and makes a very inferior tobacco. Frequently infected leaves finally show numerous, irregular, often merging, brown spots known as "rust." While calico is a physiological disease, due to injurious enzymes, it can be communicated to a healthy plant through contact with a very small amount of juice from a diseased plant. Care, therefore, is necessary after handling diseased plants in touching healthy ones. Never use tobacco water or tobacco stems on the seed beds. If calico shows in a

seed bed, pull up all suspicious plants and those surrounding them. If troubled year after year, sterilize the seed beds or change them, and never make them on land used for tobacco the year before. When transplanting, wash the hands occasionally with soap and water. Repts. 1898, p. 242; 1899, p. 252; 1914, p. 357; Bull. 166, p. 10.

**Dampening Off**—Due to various fungi which rot off the seedlings close to the ground, and cause them to fall over. Keep air of beds as dry as consistent with good growth by care in watering and ventilating. If trouble starts in spots, take out all infected plants and refuse there.

**Root Rot**—Shows in seed beds by dwarfed "rosette" plants whose roots have been largely rotted off. Occasionally it does more or less damage in fields, especially in alkaline or water soaked soils; a short rotation is advisable in such cases. Sterilize seed beds with steam or treat with formalin (formula D). Repts. 1906, p. 342; 1907, p. 363.

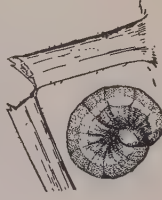


**Wild Fire**—Shows first in lower leaves as small, roundish, yellow spots. In time these grow larger, turn darker, and irregular dead areas appear more or less prominently. This disease is caused by bacteria, is favored by wet weather and is apparently new to the state. It is carried on the seed and later may be readily transferred from infected places in the field by certain insects and the wind. Care should be used to select seed only from disease-free fields and sow this seed in sterilized seed beds. Where doubtful seed is used this should be soaked for 15 minutes in 1 pint of water to which is added 1 oz. of formalin, stirring the seed during the treatment. Drain off the liquid, wash seed in pure water several times and dry before storing. Old cloth used previously on infected beds should be boiled in water before used again.

## TOMATO.

### *Insects.*

**Cut Worms**—Eat off plant near ground or climb the plant and devour the leaves. Place around field poisoned bait or bran mash containing arsenic. Trap cut worms with small



piece of board. Rept. 1906, p. 264; Bulls. 190, p. 18; 208, p. 112; 216, p. 43.

**Tomato or Tobacco Horn-Worm**—See Tobacco.

**Flea Beetle**—See Potato or Tobacco.

**Potato Aphid**—See Potato.

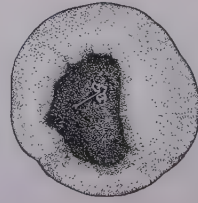
**Stalk Borer**—See Dahlia.

**White Fly**—Sucks the sap from under side of leaves. Spray under side of leaves with soap and water. Fumigate greenhouses with hydrocyanic acid gas (1 oz. to 1000 cubic ft.). Bulls. 140; 216, p. 50; Rept. 1902, p. 148.

*Fungi, etc.*

**Mosaic**—Rept. 1908, p. 857. See Calico of Tobacco.

**Leaf Spot**—Produces on leaves and stems numerous, small, dark spots, often with white centers. Begin spraying with Bordeaux about the middle of July, making 3 or 4 applications at intervals of 10-14 days. This usually develops too late in the season here to cause serious damage.



**Point Rot**—Causes the green fruit to rot at bloom end, showing a large, firm, dark-brown area. Claimed to be a physiological trouble. Frequently bad in very dry seasons. In greenhouses sub-irrigation is said to prevent it. Spraying, apparently, is of little value. Considerable difference exists in varieties as to susceptibility.

**Scab**—Occurs most commonly in greenhouses, covering under surface of leaves more or less abundantly with an olive-brown growth which finally kills the tissue above. Spray with Bordeaux, picking ripe fruit before each of the later treatments.

**Wilt**—Occurs here chiefly in greenhouses; plants turn yellow and slowly wither up; fungus may finally show on dead stem and fruit as pinkish growth. Caused by fungus clogging ducts and cutting off water supply to leaves; in young stage presence shown by blackened bundles where stems are cut across. Change soil if appearing yearly; do not sow seeds from infected plants as they can carry the disease. Spraying of no value. Rept. 1903, p. 366.

## TULIP TREE.

*Insects.*

**Tulip Tree Scale**—Large brown hemispherical soft scales on bark, sucking the sap, especially on lower branches. Spray with lime-sulphur when trees are dormant. Bull. 151; Repts. 1905, p. 239; 1912, p. 294.

## TURNIP-RUTABAGA.

*Insects.*

**Cut Worms**—See Tomato.

**Cabbage Maggot**—See Cabbage.

**Turnip Aphid**—Green aphids on under side of leaves sucking the sap. Underspray with soap and water or nicotine solution. Rept. 1916, p. 98.

*Fungi, etc.*

**Club Root**—See Cabbage.

**Soft Rot**—Causes an interior soft decay of roots, etc., of a variety of vegetables, such as turnips, salsify, parsnips, carrots, celery. Very wet seasons and imperfect storage conditions are usually the starting point of these troubles. Store under best possible conditions for keeping down heat and moisture. Keep contaminated refuse out of manure pile. Rept. 1914, p. 25.



**Phoma Rot**—Appears usually after storage, causing conspicuous, dry, sunken, subcircular, black spots scattered over roots. Fruiting pustules show as black dots. Store roots in cool dry place and not too deeply in the piles. Practice yearly rotation and keep refuse from manure pile. If necessary, use only artificial fertilizers. Rept. 1912, p. 355.

*Insects, etc.*

#### VIOLET.

**Violet Midge**—Larvae in curled edges of new leaves. Fumigate every other night with hydrocyanic acid gas ( $\frac{1}{2}$  oz. to 1000 cu. ft.)

**Violet Sawfly**—Larvae devour leaves. Spray with lead arsenate or hellebore.

**Elworms**—Form galls on the roots. Plant in new soil or sterilize the old soil by steam. Add plenty of air-slaked lime to the soil. See Snapdragon.

*Fungi.*

**Spot Disease**—Shows as whitish round spots on the leaves. Spray field plants early in fall with Bordeaux. Select only best stock for greenhouse; remove *all* affected leaves before transplanting. When plants become established, spray again with Bordeaux. Be careful about watering plants, and, by proper ventilation and heat during September to November, keep atmosphere of house from ever becoming too moist.

#### WALNUT.

*Insects.*

**Walnut Caterpillar**—Clusters of black caterpillars covered with whitish hairs strip the branches and finally the trees in August. Spray with lead arsenate. Clip off twigs when caterpillars are small, and kill by crushing. Repts. 1914, p. 191; 1917, p. 326.

**Walnut Weevil** or **Curculio**—Adults feed at base of leaf stems. Larvae tunnel in new shoots and infest the fruit of Persian

and Japanese walnuts. Spray with lead arsenate. Rept. 1912, p. 240.

**Walnut Bud Moth**—Larvae feed upon tender leaves and shoots, webbing them together. Spray with lead arsenate. Rept. 1912, p. 253.

#### WATERMELON.



**Anthracnose**—Shows as more or less abundant, dark, sunken spots or areas on the fruit. Also, infects leaves in spots. Usually appears here too near end of season to cause sufficient injury to warrant spraying; spray also fails to adhere well to the fruit. Rotation and removal of rotting melons from field may possibly be helpful restrictive measures.

#### WHEAT.

*Insects.*

**Army Worm**—See Grass.

**Hessian Fly**—Maggot burrow in sheath of a leaf at base of stem, causing the stalks to turn yellow and die. Plant rather late—say about September 1st.

**Wheat Midge**—The fly lays eggs on the chaff and the maggots feed upon the developing kernels, so that the heads ripen early and produce no grain. Burn stubble before plowing. Plow infested fields deeply in the fall. Rept. 1917, p. 366.

**Green Bug** or **Aphid**—Green aphids suck the sap from leaves. Destroy in early fall all volunteer wheat and oats. Practice crop rotation.

*Fungi.*

**Black Stem Rust**—See Oats.

**Leaf Rusts**—Form small, dusty, orange-colored outbreaks on leaves, etc., and later darker and firmer mature stage. Several



closely related species on barley, rye, and wheat but quite distinct from the black stem rust. Some varieties are more resistant than others to these various grain rusts. No effective treatment.



**Loose Smut**—Destroys entire head turning it into a dusty olive-black mass that is dissipated in time. Severe hot water treatment partially effective. See Oats.

**Stinking Smut**—Fills the apparently scarcely changed seeds with a dusty mass of spores. Spores often found more or less abundantly in middlings and other feeds containing wheat, and their presence in amount indicates poor quality, and may have some connection with complaints of injury to stock fed on these. Use formalin treatment. Rept. 1909-10, p. 736.

## *Insects.*

## **WILLOW.**

**Fall Web Worm**—See Pear.

**Spiny Elm Caterpillar**—See Elm.

**Poplar Tent-Maker**—See Poplar.

**Poplar and Willow Curculio**—See Poplar.

**Sawflies**—Larvae devour leaves. Spray with lead arsenate.

**Aphids**—Large reddish aphids congregate on twigs in fall, and suck the sap. Spray with kerosene emulsion or nicotine solution and soap.

**Oyster-Shell Scale**—See Apple.

## *Fungi.*

**Rusts**—Occur on the leaves; similar in appearance and closely related to those on poplar. The alternate host for one species is the larch and apparently there is another whose alternate host is not yet determined. Rept. 1915, p. 450.

## MANUFACTURERS AND DEALERS IN SPRAY APPARATUS AND SUPPLIES.

Prospective purchasers should write to these firms for catalogues and prices.

### MANUFACTURERS OF SPRAYING MACHINES.

- Aspinwall Manufacturing Co., Jackson, Mich. (Hand and power potato sprayers.)
- Barnes Mfg. Co., Mansfield, Ohio. (Hand and power sprayers.)
- Bateman Mfg. Co., Grenloch, N. J. (Iron Age sprayers for hand and power.)
- Bean Spray Pump Co., Lansing, Mich. (Hand and power outfits.)
- Brckett, Shaw & Lunt Co., Somersworth, N. H., 62 No. Washington St., Boston, Mass. (Hand and power outfits.)
- Brown Co., E. C., Rochester, N. Y. (Compressed air, hand and power outfits.)
- Church, Stephen B., Seymour, Conn., 64 Pearl St., Boston, Mass. (Power and hand sprayers.)
- Crestline Mfg. Co., Crestline, Ohio. (Sprayers.)
- Cushman Sprayer Co., St. Joseph, Mo. (Power outfits.)
- Dayton Manufacturing Co., 2240 East Third St., Dayton, Ohio. (Hand sprayers.)
- Deming Co., Salem, Ohio. (Hand and power outfits.)
- Douglas, W. & B., Middletown, Conn., (Hand and power pumps.)
- Field Force Pump Co., Elmira, N. Y. (Hand and power pumps.)
- Fitzenry-Guptill Co., 135 First St., Cambridge, Mass. (Power sprayers.)
- Friend Mfg. Co., Gasport, N. Y. (Power and hand pumps.)
- Goulds Mfg. Co., 58 Pearl St., Boston, Mass.; 16 Murray St., New York. (Hand and power sprayers.)
- Hardie Mfg. Co., Hudson, Mich.; Hagerstown, Md. (Hand and power pumps.)
- Hayes Pump and Planter Co., Galva, Ill. (Spray pumps.)
- Humphreys Mfg. Co., Mansfield, Ohio. (Hand and power pumps.)
- Hurst Mfg. Co., H. L. Greenwiche, Ohio.
- Leggett & Brother, 301 Pearl St., New York. (Hand and power dusting machines.)
- Myers & Brother, F. E., Ashland, Ohio. (Hand and power pumps.)
- Niagara Sprayer Co., Middleport, N. Y. (Dusting machines.)
- Rumsey Pump Co., Ltd., 49 Federal St., Boston, Mass. (Hand and power pumps.)
- Spramotor Co., 107-109 Erie St., Buffalo, N. Y. (Hand and power outfits.)
- Ward-Love Pump Corporation, Rockford, Ill. (Pumps for all purposes.)
- Heil Chemical Co., Henry St. Louis, Mo. (Spray chemicals.)
- Hemingway & Co., Inc., Bound Brook, N. J. (Arsenical poisons.)
- Interstate Chemical Co., 12-20 Bay View Ave., Jersey City, N. J. (Insecticides and fungicides.)
- Kentucky Tobacco Product Co., Louisville, Ky. (Nicotine solution.)
- Kil-Tone Co., The, Vineland, N. J. (Insecticides and fungicides.)
- Lavanburg Co., Fred L., 100 William St., New York. (Arsenical poisons.)
- Leggett & Brother, 301 Pearl St., New York. (Insecticides and fungicides.)
- Meckling Bros. Mfg. Co., Line St., Camden, N. J. (Insecticides and fungicides.)
- Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Lead arsenate.)

### MANUFACTURERS OF INSECTICIDES AND FUNGICIDES.

- Blanchard Co., Jas. A., Hudson Terminal Bldg., 30 Church St., New York. (Insecticides and fungicides.)
- Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Insecticides and fungicides.)
- Devoo & Raynolds Co., Inc., 101 Fulton St., New York. (Arsenical poisons.)
- Frost Insecticide Co., 20 Mill St., Arlington, Mass. (Spray chemicals and apparatus.)
- General Chemical Co., 25 Broad St., New York. (General insecticides and fungicides, atomic sulphur and B. T. S.)
- Glidden Co., Cleveland, Ohio. (Insecticides and fungicides.)
- Grasselli Chemical Co., 80 Maiden Lane, New York. (Insecticides and fungicides.)



National Color and Chemical Works, Selling Agents for Taylor Chemical Co., 59th St. & 11th Ave., New York. (Carbon disulphide.)  
 Niagara Sprayer Co., Middleport, N. Y. (Dusting materials.)  
 Nitrate Agencies Co., 85 Water St., New York. (Arsenical poisons.)  
 Pratt Co., B. G., 50 Church St., New York. (Miscible oils.)  
 Riches, Piver & Co., 30 Church St., New York. (Arsenical poisons.)  
 Robertson Co., The J. T., 147 Richmond Ave., Syracuse, N. Y. (Miscible oils.)

Roessler & Hasslachner Chemical Co., 100 William St., New York. (Cy-  
 anide.)  
 Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio. (Lime-sulphur  
 and arsenical poisons.)  
 Smith Co., H. J., Utica, N. Y. (Insecticides and Fungicides.)  
 Thum Co., O. & W., Grand Rapids, Mich., 15 India St., Boston, Mass.  
 (Tanglefoot.)  
 Vreeland Chemical Mfg. Co., 50 Church St., New York. (Insecticides  
 and fungicides.)

## CONNECTICUT DEALERS IN SPRAYING SUPPLIES.

Dealers in spraying materials can usually be found in each town. Some of the larger firms are mentioned below.

Apothecaries Hall Co., 24 Benedict St., Waterbury. (Wholesale drug-  
 gists.)  
 Barnes Bros., Yalesville. (Insecticides and fungicides.)  
 Cadwell & Jones, 1084 Main St., Hartford. (Pumps, insecticides and  
 fungicides.)  
 Grasselli Chemical Co., River St., New Haven. (Insecticides and fungi-  
 cides.)  
 Henry & Son, W. A., Blue Hills Farm, Wallingford. (Friend sprayers.)  
 Jewell, Harvey, Cromwell. (Agent for Hardie hand and power sprayers.)

Leete Co., The Chas. S., 299 State St., New Haven. (Wholesale druggists.)  
 Lightbourn & Pond Co., 39 Broadway, New Haven. (Pumps, insecti-  
 cides and fungicides.)  
 Platt Co., The Frank S., 450 State St., New Haven. (Pumps, insecti-  
 cides and fungicides.)  
 Sisson Drug Co., 729 Main St., Hartford. (Spraying machines and  
 insecticides.)  
 Whittlesey Co., The Chas. W., 259-271 State St., New Haven. (Whole-  
 sale druggists.)